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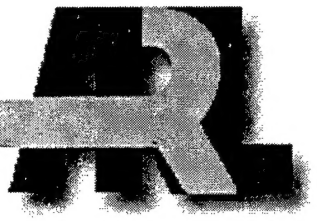

Development of a Team Performance Task Battery to Evaluate Performance of the Command and Control Vehicle (C2V) Crew

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Abstract

Requirements for mobility and speed in battle command led to the development of a mobile, digitized command and control vehicle (C2V). Conducting battle command in a C2V impacts how the individual and team will acquire, process, and disseminate information. To test the effect that the C2V will have on battle command performance requires an evaluation of both individual and team performance. Cognitive test batteries exist to assess individual performance. The current effort was to develop a task battery for use in evaluating team performance. Four team performance functions (information exchange, resource matching, coordination, and error checking) were proposed and used to guide the selection of tasks to form a team performance task battery. Tasks were selected from a large sample of group tasks identified and assessed for applicability to the team performance functions. Tasks that most exemplified each of the four functions and that could be used to support the C2V test were compiled into a task list and developed for implementation. Task development included creating, gathering, or assembling stimulus materials, instructions, and test protocols. Manual versions of all the selected tasks and digital versions of some tasks were developed. A sufficient number of replications of each task were developed to support the C2V test design. Four of the tasks developed were used during the C2V test. It was concluded that the C2V environment impaired performance of all group performance tasks, especially those that required a great degree of coordination and integration. Future research must expand this initial effort to empirically define and validate team functions and related tasks.

ACKNOWLEDGMENTS

This work was supported by the USAFAS Field Element, Human Research and Engineering Directorate of the U.S. Army Research Laboratory, Fort Sill, Oklahoma, Contract No. DAAL01-96-P-0875. The contributions of Douglas Tyrol, Richard Tauson, and Charles Robledo are gratefully acknowledged.

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FIGURE

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EXECUTIVE SUMMARY

The U.S. Army is developing a tracked, highly digitized command and control vehicle (C2V) with a speed comparable to that of the combatant force to increase battle staff capability. The C2V crew will be expected to work individually and as part of a team within and between C2Vs. U.S. Army acquisition regulations require new systems to be evaluated under a variety of conditions before they are fielded. Procedures and techniques exist for evaluating system capabilities and the ability of the individual to operate the system. A team performance evaluation system is required.

The goal was to develop a preliminary task battery to assess a subset of team performance functions judged to be closely related to the functions performed by C2V crews. Similar approaches have been used and are accepted to evaluate fundamental cognitive functions of individuals. The current effort represents an expansion of the individual approach to the study of teams.

The pioneering conceptual and empirical work summarized by Fleishman and Zaccaro (1992) influenced the selection of team performance functions. A preliminary list of functions was clarified and finalized after group laboratory tasks were rated on the degree to which each function was important for successful performance and after discussions were held among the research team members. The final team performance taxonomy consisted of the following functions: information exchange, resource matching, coordination, error checking, and motivation. The importance, in other contexts, of motivational functions was acknowledged but an evaluation of motivational functions was not included in the current effort.

Tasks were selected from articles published in refereed psychological or business journals in the years 1991 through 1995, and a set of tasks was abstracted by McGrath in 1984. A large set of 152 group tasks resulted. Each task was abstracted and discussed by the research team. Following an initial decision to keep 39 of the 152 tasks, the team rated the tasks twice based on the degree to which the tasks required a function for optimal performance. Even though inter-rater agreement was not high, it was necessary to proceed toward task selection and development to support the C2V test, and a preliminary task list that most exemplified each of the four functions was compiled.

Task development included creating, gathering, or assembling stimulus materials, instructions, and test protocols and proposing dependent variables of interest. Manual versions

of all the selected tasks and digital versions of some tasks were developed. The most difficult problem in task development was the creation of a sufficient number of versions of each task to support the C2V test design. Another issue involved determining the amount of time to assign to a replication of each task and coordinating those times with the test protocol.

The C2V limited user test (LUT) was conducted to discover if movement impaired the ability of crews to work effectively as a team, determine if performance deteriorated when soldiers in adjacent C2Vs were required to integrate their activities, and ascertain the impact of terrain on group performance (Beck & Pierce, 1998). The test used two C2V prototypes staffed with a four-person team. Each team member operated a workstation in the vehicle's mission module. The evaluation design was similar to 2 (Movement: Stationary, Moving) x 2 (Terrain: Paved, Course A) x 2 (Communication: Intravehicle, Intervehicle) with the baseline occupying the position of the nonfitting control arrangement. Four group performance tasks from the final task list were selected for implementation. The tasks selected for use during the C2V LUT were the nonsummation (renamed sentence construction), Scrabble No. 2, Social Judgment, and Quiz Tasks. It was concluded that the C2V environment impaired performance of all group performance tasks, especially those that required a great degree of coordination and integration (Beck & Pierce, 1998).

Although the team performance task battery was useful for evaluating team performance in the C2V, further development of this battery is necessary before it can be systematically used to support system evaluation. The proposed functions must be assessed for criticality in battle command performance, and the empirical relationship between the tasks and the group functions must be established and additional tasks derived and validated for use in the task battery. A scientifically derived team performance task battery may significantly improve test and evaluation of information age technology.

DEVELOPMENT OF A TEAM PERFORMANCE TASK BATTERY TO EVALUATE PERFORMANCE OF THE COMMAND AND CONTROL VEHICLE (C2V) CREW

INTRODUCTION

The development of the mobile, digitized command and control vehicle (C2V) by the Army will have far-reaching effects on the performance of command and control functions. Digitization, for example, results in large amounts of information becoming available within short periods of time, while mobility results in a highly dynamic informational environment. C2V crews not only acquire and process information but must also disseminate raw data or decisions to the appropriate agency or individual while maintaining some level of situational awareness and synchronizing their efforts to perform group level activities. Thus, to conduct a comprehensive assessment of C2V crew performance, both the individual and group levels must be considered.

Cognitive test batteries to evaluate individual level performance of tasks that tap the fundamental, underlying functions required of C2V crew members are readily available. Indeed, a form of the Complex Cognitive Assessment Battery (CCAB) has already been used for this purpose (Tauson, Doss, Rice, Tyrol, & Davidson, 1995). However, no such task battery exists to measure crew performance functioning. Efforts to categorize team tasks in relation to military team performance functions have focused on real tasks or simulations of real tasks that were neither designed nor suitable for the assessment of underlying functions. Thus, the goal of this work was to develop a preliminary task battery to assess a subset of team performance functions judged to be closely related to the functions performed by C2V crews.

TEAM FUNCTION TAXONOMIES

The initial task involved a review of group task classifications in order to generate a taxonomy that would guide the development of a team performance task battery. From the earliest days of the study of groups, it was recognized that the task assigned to a group strongly determines group process and performance (e.g., Thorndike, 1938). Consequently, many schemes to classify group tasks have been proposed. Beyond simple dichotomies (easy or difficult; intellectual or motor) and ad hoc classifications (e.g., Lorge, Fox, Davitz, & Brenner, 1958), the most common ways of classifying tasks have been on the basis of (a) the behaviors required by or elicited by the task, (b) the nature of the task products, or (c) the relationship between the members of a group performing the task (McGrath, 1984).

Steiner's (1972) classification is the best known scheme for classifying tasks on the basis of task product. Steiner defined tasks in terms of the permissible ways of combining individual resources into a group product. For unitary tasks (those that cannot reasonably or profitably be divided into subtasks) Steiner described four subtypes. In additive tasks, the products of group members are weighted equally and summed in determining group product. For disjunctive tasks, to calculate the group product, the total weight is assigned to the one member (or several members with the same product) who can successfully complete the task. In other words, maximum group performance is equal to the performance of the best member. The group product for conjunctive tasks is determined by assigning total weight to the product of the least able member, as when, for example, a column of marching soldiers is said to arrive at its destination when the slowest soldier arrives. Finally, in discretionary tasks, any way of combining member products (adding, averaging, blending) may be allowed in determining the group product.

Divisible tasks, on the other hand, are those that can reasonably be divided into subtasks. Performance of subtasks may be disjunctive, conjunctive, additive, or discretionary. The task of combining subtask products may be disjunctive, conjunctive, additive, or discretionary. Most often, it is disjunctive, and some tasks do not require any integration of subtasks. The division of the task into subtasks and the assignment of members to subtasks may be assumed for a particular task or it may be discretionary. Steiner's classification is important because it highlights the fact that the assessment of group performance may vary widely, depending on the explicit or implicit task rules under which a group does the task and the way in which the group product is determined.

McGrath (1984) incorporated elements from earlier classification schemes, some of which focused on the behaviors elicited by the task, and others that focused on the relationship between the members of the group performing the task. From this, he produced a comprehensive classification in the form of a group task circumplex (see Figure 1). The circumplex is defined by two underlying dimensions, conceptual versus behavioral and conflict versus cooperation, that correspond respectively to required behavior and relations between members.

The circumplex itself has four quadrants that correspond to more specific behaviors that groups must actually do to complete a task: Generate (high cooperation), Choose (high conceptual), Negotiate (high conflict), and Execute (high behavioral). Within each quadrant are two task types differentiated by their relative standing on the complementary dimension. Planning tasks (more behavioral) and Creativity tasks (more conceptual) comprise the Generate quadrant. Intellective tasks (more cooperation) and Decision-Making tasks (more conflict) comprise the Choose quadrant. In the Negotiate quadrant are Cognitive Conflict tasks (more conceptual) and Mixed Motive tasks

(more behavioral), while the Execute quadrant includes Contests/Battles/Competitive Tests (more conflict) and Performances/Psycho-motor tasks (more cooperation). These eight task types are arranged around a circumplex in the order given just above ranging from Planning tasks around to Performances/Psycho-motor tasks and back to Planning so that the closer tasks are on the circumplex, the more similar they are. The group task circumplex is a valuable contribution to task classification because of its comprehensiveness and because it specifies the relationships between tasks in terms of a few underlying dimensions.

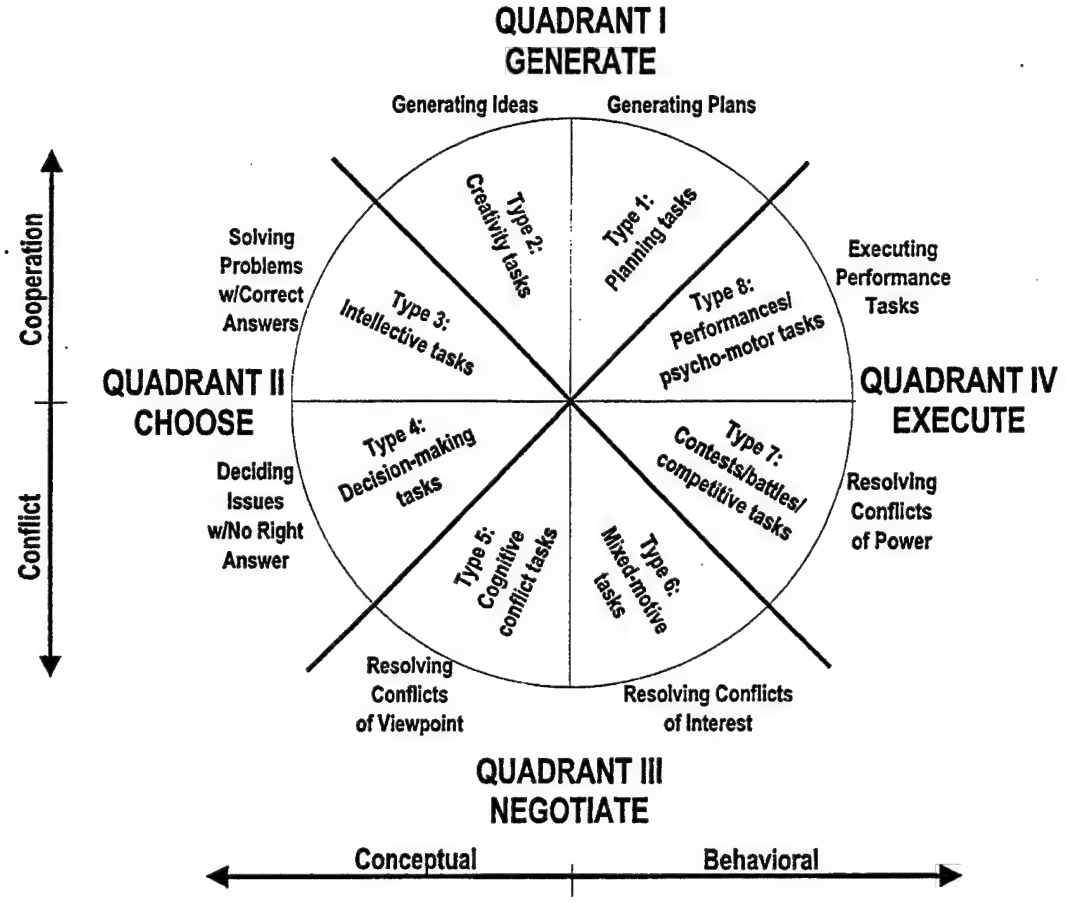

Figure 1. The group task circumplex.[1]

In order to classify tasks, McGrath's circumplex employs overt behaviors that define the completion of tasks (e.g., choosing a decision alternative, generating a plan, resolving a cognitive conflict). In completing any task, however, there are generic group-level behaviors that constitute group process. At the most fundamental level, these activities can be identified by the functions that they serve. For example, in making a decision or resolving a cognitive conflict, groups may

[1] From Groups: Interaction and Performance (p. 61), by J. E. McGrath, 1984, Upper Saddle River, New Jersey: Prentice Hall. Copyright 1984 by Prentice Hall. Reprinted with permission.

exchange unique or partially shared information. In executing a psychomotor task, groups may deploy their resources or coordinate the efforts of individuals. The comparative assessment of generic team performance in a small sample of tasks (e.g., in C2V and control environments) can be accomplished only by measuring performance that reflects such underlying group functions. The logic of starting with a taxonomy of functions in developing assessment batteries for individuals is well understood and widely employed (Fleishman & Quaintance, 1984). We attempted to extend that logic to team performance.

McGlynn (1991) employed a functional approach as a means of classifying group laboratory tasks. According to that approach, the nature of group tasks is such that they involve a certain degree of each of a few functional group-level elements. Simple, one-stage, indivisible tasks will include fewer functions; complex, divisible, multi-stage tasks will include a greater number of functions, perhaps mixed in complex form. Moreover, the effect of any function may be moderated by the temporal point at which it occurs in the task. Functions that occur earlier may have larger effects on overall performance to the extent that they make performance of functions at later stages more or less difficult.

Nonetheless, if a set of basic functions can be identified, any task should be able to be analyzed as to the likelihood that a given process will have to occur for successful task completion. McGlynn (1991) proposed a tentative list of group functions suggested by the group performance literature in social psychology as a means of organizing that literature. The list is presented in Table 1. These hypothesized functions were inferred from the literature and reflect, in part, the relative emphasis that basic researchers have put on different theoretical problems. At the time, no thought was given to military team tasks or to any other application. In view of that fact, it was striking to note the parallels between McGlynn's list and the team performance taxonomies that had been developed independently mainly on the basis of the applied literature (Fleishman & Zaccaro, 1992; Nieva, Fleishman, & Rieck, 1978; Shifflett, Eisner, Price, & Schemmer, 1982).

The taxonomy developed by Nieva et al. (1978) is presented in Table 2 and the final modification of that taxonomy by Fleishman and Zaccaro (1992) is given in Table 3. The preliminary taxonomy developed by Nieva et al. was revised by Shifflett et al. (1982) and then validated by a process of rating videotapes of Army combat and combat support teams (Shifflett et al., 1982) and Air Force command and control teams (Cooper, Shifflett, Korotkin, & Fleishman, 1984). As a result of these studies, in which raters used validated behavioral rating scales, Cooper et al. identified additional functions (systems monitoring and procedure maintenance) which were

added to the scheme. Other details of the development of the final taxonomy were summarized by Fleishman and Zaccaro (1992).

Table 1

Tentative List of Group Functions

Motivational effects
Cognitive effects
Cognitive stimulation
Resource sharing
Pooling of judgments
Pooling of information
Information integration
Error checking
Group to individual transfer over course of task
Normative influence processes

From McGlynn (1991)

Table 2

Nieva, Fleishman, and Rieck (1978) Preliminary Taxonomy

I. Team orientation functions
- A. Elicitation and distribution of information about team goals
- B. Elicitation and distribution of information about team tasks
- C. Elicitation and distribution of information about team member resources and constraints

II. Team organizing functions
- A. Matching member resources to task requirements
- B. Response coordination and sequencing of activities
- C. Activity pacing
- D. Priority assignment among tasks
- E. Load balancing of tasks by members

III. Team adaptation functions
- A. Mutual critical evaluation and correction of error
- B. Mutual compensatory performance
- C. Mutual compensatory timing

IV. Team motivational functions
- A. Development of team performance norms
- B. Generating acceptance of team performance norms
- C. Establishing team-level performance-rewards linkages
- D. Reinforcement of task orientation
- E. Balancing team orientation with individual competition
- F. Resolution of performance-relevant conflicts

From Fleishman and Zaccaro (1992)

Table 3

Fleishman and Zaccaro (1992) Taxonomy of Team Functions

I. Orientation functions
- A. Information exchange regarding member resources and constraints
- B. Information exchange regarding team task and goals and mission
- C. Information exchange regarding environmental characteristics and constraints
- D. Priority assignment among tasks

II. Resource distribution functions
- A. Matching member resources to task requirements
- B. Load balancing

III. Timing functions (activity pacing)
- A. General activity pacing
- B. Individually oriented activity pacing

IV. Response coordination functions
- A. Response sequencing
- B. Time and position coordination of responses

V. Motivational functions
- A. Development of team performance norms
- B. Generating acceptance of team performance norms
- C. Establishing team-level performance-rewards linkages
- D. Reinforcement of task orientation
- E. Balancing team orientation with individual competition
- F. Resolution of performance-relevant conflicts

VI. Systems monitoring functions
- A. General activity monitoring
- B. Individual activity monitoring
- C. Adjustments of team and member activities in response to errors and omissions

VII. Procedure maintenance
- A. Monitoring of general procedural based activities
- B. Monitoring of individual procedural based activities
- C. Adjustments of nonstandard activities

From Fleishman and Zaccaro (1992)

Notably, error checking and other systems monitoring functions, which were incorporated into other functions in the first revision of the taxonomy, were found to be critically important in the validation and were separated in the final version. Such a finding is consistent with the

important role of error checking in basic research as far back as Shaw (1932). Likewise, both information exchange (and pooling) and motivational functions were conceived similarly based on both the basic (McGlynn, 1991) and applied literature (Fleishman & Zaccaro, 1992). On the other hand, McGlynn's list, consistent with trends in social psychology, emphasizes cognitive functions, whereas the taxonomies developed in the military context emphasize overt behavior.

In developing a taxonomy that would be most useful for developing a task battery, we relied heavily on the pioneering conceptual and empirical work summarized by Fleishman and Zaccaro (1992). As noted there, however, there is a difference between classifying tasks on the basis of the behaviors actually elicited by the task in practice versus the inferred processes that the task requires for successful completion in principle. The former approach is more descriptive and is appropriate for classifying real tasks. The latter approach is more suited for developing generic tasks that tap the underlying functions.

Several considerations resulted in modifying the Fleishman and Zaccaro classification into the initial and final versions of the taxonomy of task demand functions that are presented in Tables 4 and 5. First, as indicated, we did not consider motivational functions beyond acknowledging their importance in other contexts, and these functions are therefore not described. Second, we folded timing functions into coordination functions in order to reduce the number of functions to be considered. Third, we modified the subcategories of each of the major remaining functions to a more narrative form because we believed that rating underlying functions was not as amenable to as fine a level of judgment as was required by the rating of overt behavior. After a large set of group laboratory tasks was rated on the degree to which each function was important for successful performance, the four major functions were clarified as a result of discussions among members of the research team, and Version 2 of the Taxonomy of Task Demands was agreed upon.

SELECTION OF GROUP TASKS

Concurrent with the effort to develop a taxonomy, the literature was searched to identify a large sample of group tasks that had been used in published studies. It seemed desirable to focus on tasks that had proved to be sensitive to experimental manipulations, and publication in refereed journals served as a sufficient indicator of that criterion. We therefore surveyed the literature for the previous 5 years, abstracted the distinct tasks identified, and combined those with a set of task abstracts provided by McGrath (1984) to produce a set of 152 group tasks. Our search was limited to journals (see Table 6) that were believed to publish most of the empirical research about small groups in the fields of psychology and business. We did not

review the extensive work on groups in communication and related fields because it tends to emphasize process more than performance. As a result of all these limitations, we had a large sample of group tasks rather than an exhaustive list.

Table 4

Taxonomy of Task Demand Functions (Version 1)

1. Information exchange functions	Information exchange regarding member resources and constraints, team task and goals or mission, environmental characteristics and constraints, or priority assignment among subtasks. Degree varies with how much of each kind of information must be exchanged, number of people involved in exchange and the uniqueness or redundancy of each member's information.
2. Resource-matching functions	Matching member resources (skills, abilities, numbers, etc.) to subtask requirements. Includes role interchange. Degree varies with number of subtasks, uniqueness of member resources required, and the variability in the number of persons required by subtasks.
3. Coordination functions	Coordinating responses with task timing requirements or with responses of other members, including activity pacing, response sequencing, and time and position coordination. Degree varies with criticality for task completion of speed, sequencing, and coordination.
4. Error-checking functions	Monitoring activity and adjusting of team and member activities in response to errors and omissions (more demonstrable) or the attainment or failure to meet standards of performance (less demonstrable). Degree varies with ability to monitor group and individual products and to provide corrective feedback (see pp. 69-70, 84-85, Cooper et al., 1984)
5. Motivational functions	We recognize the importance of motivational functions, but in regard to C2V performance, we assume that motivation is sufficiently high (cf. Cooper et al., 1984).

Table 5

Taxonomy of Task Demand Functions (Version 2)

1. Information exchange functions	Information exchange regarding member resources and constraints, team task and goals or mission, environmental characteristics and constraints, or priority assignment among subtasks. Degree varies with, for example, the uniqueness or redundancy of each member's information, the usefulness of the information to other members, how much of each kind of information must be exchanged, and the number of people involved in exchange.
2. Resource-matching functions	Matching member resources (skills, abilities, prior knowledge, task information, numbers, etc.) to subtask requirements. Includes role interchange. Degree varies with, for example, uniqueness of member resources required, number of subtasks requiring matching, and the variability in the number of persons required by subtasks.
3. Coordination functions	Coordinating responses with task timing requirements or with responses of other members, including activity pacing, response sequencing, and time and position coordination. Degree varies with, for example, criticality for task completion of coordination, or sequencing, or speed.
4. Error-checking functions	Monitoring activity, identifying problems, and adjusting team and member activities in response to errors and omissions (more demonstrable) or the attainment or lack of attainment of standards of performance (less demonstrable). Degree varies with, for example, ability to monitor group and individual products and to provide corrective feedback (see pp. 69-70, 84-85, Cooper et al., 1984) and the degree to which error-free performance is important.
5. Motivational functions	We recognize the importance of motivational functions, but in regard to C2V performance, we assume that motivation is sufficiently high (cf. Cooper et al., 1984).

Table 6

Journals Searched for Group Tasks

Journal of Personality and Social Psychology
Journal of Experimental Social Psychology
Organizational Behavior and Human Decision Processes
Small Group Research
Journal of Applied Social Psychology
Basic and Applied Social Psychology
Group and Organization Management
Administrative Science Quarterly
Academy of Management Journal

Three research assistants undertook the job of identifying articles that employed potentially suitable group tasks. Because the taxonomy was still being developed (mainly by the principal investigator), the search for group tasks was not particularly selective. Each task identified was abstracted according to the form used by McGrath (1984): main study procedures, main dependent variables, main variations, and bibliographic reference. As this search continued, the abstracts were circulated among all research team members in order to avoid redundancy and facilitate the development of the taxonomy.

The research assistants identified tasks from this list that were not redundant, that were sufficiently complex, and that showed some promise for inclusion in the final battery. Unanimous decisions made were to keep (15 tasks) or reject (71 tasks) 86 of the 152 tasks. The remaining 66 tasks were each discussed by the three assistants until consensus was reached. As a result, 24 more tasks were retained for consideration, making a total of 39. Table 7 contains a list of the tasks retained and removed from consideration at this stage.

The 39 tasks were subjected to ratings by the research assistants on the four functions (motivational function excluded) from Version 1 of the Taxonomy of Task Demand Functions. The functions were originally rated using a seven-point scale according to the following criteria: "Consider each task with respect to Functions 1 though 4 and rate the degree to which the task requires each function for optimal performance." It was found that interpretations of the taxonomy functions differed among the three raters, which resulted in low levels of agreement. After considerable discussion to clarify the taxonomy, Version 2 was agreed upon, and the assistants independently rated the tasks again on a five-point scale for which 1 = little or none of

the function required and 5 = very high degree of the function required. The ratings resulting from this round are shown in Table 8.

Table 7

Initial Task List

Task No.	Task name and reference
	Tasks retained
3	Allocation of Sales Territory Task
	Reference: Henry, R. A. (1995). Using relative accuracy judgments to evaluate group effectiveness. Basic and Applied Social Psychology, 16, 333-350.
8	Behavioral Intentions Task
	Reference: Barr, S. H., & Conlon, E. J. (1994). Effects of distribution of feedback in work groups. Academy of Management Journal, 37, 641-655.
9	Brainstorming Task
	Reference: Diehl, M., & Strobe, W. (1991). Productivity loss in idea-generating groups: Tracking down the blocking effect. Journal of Personality and Social Psychology, 392-403.
10	Business Policy Task
	Reference: Wheeler, B. C., Mennecke, B. E., & Scudder, J. N. (1993). Restrictive group support systems as a source of process structure for high and low procedural order groups. Small Group Research, 24, 504-522.
11	Rule Induction Task
	Reference: Laughlin, P. R., VanderStoep, S. W., & Hollingshead, A. B. (1991). Collective versus individual induction: Recognition of truth, rejection of error, and collective information processing. Journal of Personality and Social Psychology, 61, 50-67.
12	Carter Racing Task
	Reference: Sitkin, S. B., & Weingart, L. R. (1995). Determinants of risky decision-making behavior: A test of the mediating role of risk perceptions and propensity. Academy of Management Journal, 38, 1573-1592.
15	Coalition Formation Task
	Reference: Mannix, E. A. (1993). Organizations as resource dilemmas: The effects of power balance on coalition formation in small groups. Organizational Behavior and Human Decision Processes, 55, 1-22.

Table 7 (continued)

17 Computer Brainstorming Task

Reference: Valacich, J. S., Dennis, A. R., & Nunamaker, J. F. Jr., (1992). Group size and anonymity effects on computer mediated idea generation. Small Group Research, 23, 49-73.

19 Computerized Thumb Problem Task

References: Paulus, P. D., Larey, T. S., Putman, V. L., Leggett, K. L., & Roland, E. J. (1996). Social influence processes in computer brainstorming. Basic and Applied Social Psychology, 18, 3-14.

Paulus, P. B., Larey, T. S., & Ortega, A. H. (1995). Performance and perceptions of brainstormers in an organizational setting. Basic and Applied Social Psychology, 17, 249-265.

24 Desert Survival Situation Task

Reference: Littlepage, G. E., Schmidt, G. W., Whisler, E. W., & Frost, A. G. (1995). An input-process-output analysis of influence and performance in problem-solving groups. Journal of Personality and Social Psychology, 877-889.

38 Hidden Profile Task

Reference: Stasser, G, & Stewart D. (1992). Discovery of hidden profiles by decision-making groups: Solving a problem versus making a judgment. Journal of Personality and Social Psychology, 426-434.

39 In-Basket Task

Reference: Chen, C. C. (1995). New trends in rewards allocation preferences: A Sino-U.S. comparison. Academy of Management Journal, 38, 408-428.

43 Integration Design Task

Reference: Pablo, A. L. (1994). Determinants of acquisition integration level: A decision-making perspective. Academy of Management Journal, 37, 803-836.

44 Nonsummation Task

Reference: Crown, D. F., & Rosse, J. G. (1995). Yours, mine, and ours: Facilitating group productivity through the integration of individual and group goals. Organizational Behavior and Human Decision Processes, 64 (2), 138-150.

47 Job-Pricing Task

Reference: Weber, C. L., & Rynes, S. L. (1991). Effects of compensation strategy on job pay decisions. Academy of Management Journal, 34, 86-109.

Table 7 (continued)

48 Judge-Advisor Task

Reference: Sniezek, J. A., & Buckley, T. (1995). Cueing and cognitive conflict in judge-advisor decision making. Organizational Behavior and Human Decision Processes, 62, 159-174.

49 Judgment Policy Task

Reference: Reagan-Cirincione, P. (1994). Improving the accuracy of group judgment: A process intervention combining group facilitation, social judgment analysis, and information technology. Organizational Behavior and Human Decision Processes, 58, 246-270.

55 Nursery School Entrapment Task

Reference: Kameda, T. (1991). Procedural influence in small-group decision making: Deliberation style and assigned decision rule. Journal of Personality and Social Psychology, 62, 346-356.

57 Old Guard Versus Young Turks Task

Reference: Pinkley, R. L., & Northcraft, G. B. (1994). Conflict frames of reference: Implications for dispute processes and outcomes. Academy of Management Journal, 37, 193-205.

59 Planning Task

Reference: Karau, S. J., & Kelly, J. R. (1992). The effects of time scarcity and time abundance on group performance quality and interaction process. Journal of Experimental Social Psychology, 28, 542-571.

61 Point Estimate and Confidence Interval Task

Reference: Lim, R. G. (1994). Eliciting confidence intervals within the context of the revision and weighting model of group consensus judgment. Organizational Behavior and Human Decision Processes, 59, 348-370.

67 Quiz Task

Reference: Littlepage, G. E. & Silbiger, H. (1992). Recognition of expertise in decision-making groups: Effects of group size and participation patterns. Small Group Research, 23, 344-355.

71 Rolling Ball Task

Reference: Tschan, F. (1995). Communication enhances small group performance if it conforms to task requirements: The concept of ideal communication cycles. Basic and Applied Social Psychology, 17, 371-393.

Table 7 (continued)

72 Scrabble No. 2 Task

Reference: Klein, H. J., & Mulvey, R. W. (1995). Two investigations of the relationships among group goals, goal commitment, cohesion, and performance. Organizational Behavior and Human Decision Processes, 61, 44-53.

74 Search for Oil Task

References: Farmer, S. M., & Hyatt, C. W. (1994). Effects of task language demands and task complexity on computer-mediated work groups. Small Group Research, 25, 331-366.

Isenberg, D. J. (1981). Some effects of time-pressure on vertical structure and decision-making accuracy in small groups. Organizational Behavior and Human Performance, 27, 119-134.

76 Selection Problem Task

Reference: Kroon, M. B. R., van Kreveld, D., & Rabbie, J. M. (1992). Group versus individual decision making: Effects of accountability and gender on groupthink. Small Group Research, 23, 427-458.

77 Sharing Blocks or Sand Task

Reference: Allison, S. T., McQueen L. R., & Schaerfl, L. M. (1992). Social decision-making processes and the equal partitionment of shared resources. Journal of Experimental Social Psychology, 28, 23-42.

82 Structure Building Task

Reference: Weldon, E., Jehn, K. A., & Pradhan, P. (1991). Processes that mediate the relationship between a group goal and improved group performance. Journal of Personality and Social Psychology, 61, 555-569.

85 Tinker Toy Task

Reference: Cronshaw, S. F., & Ellis, R. J. (1991). A process investigation of self-monitoring and leader emergence. Small Group Research, 22, 403-420.

87 Vocabulary Words Task

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132 Nominal Group Task

Reference: Delbecq, A. L., Van de Ven, A. H., & Gustafson, D. H. (1975). Group techniques for program planning. Glencoe, IL: Scott, Foresman.

134 Programmed Opponent Task

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2	Airliner Threats Task Reference: Anderson, S. D., & Wanberg, K. W. (1991). A convergent validity model of emergent leadership in groups. Small Group Research, 22, 380-397.
4	Asian Disease Task Reference: Tindale, R.S., Sheffey, S., & Scott, L. A. (1993). Framing and group decision-making: Do cognitive changes parallel preference changes? Organizational Behavior and Human Decision Processes, 55, 470-485.
5	Assembly Task Reference: Cella, D. F., Posig, M., Johnson, D., & Janega, D. (1993). Effects of social cues, task complexity, and sex on intrinsic motivation and task perceptions: A test of the task-instrumentality hypothesis. Basic and Applied Social Psychology, 14, 87-102.
6	Attitudinal Multi-alternative Task Reference: Kerr, N. L. (1992). Group decision making at a multi-alternative task: Extremity, interfaction distance, pluralities, and issue importance. Organizational Behavior and Human Decision Processes, 52, 64-95.
7	Step-Level Public Good Task Reference: Kerr, N. L., & Kaufman-Gilliland, C. M. (1994). Communication, commitment, and cooperation in social dilemmas. Journal of Personality and Social Psychology, 66, 513-529.
13	Child Custody Task Reference: Propp, K. M. (1995). An experimental examination of biological sex as a status cue in decision-making groups and its influence on information use. Small Group Research, 26, 451-474.
14	Choice Shift and Group Polarization Task Reference: Zuber, J. A., Crott, H. W., & Werner, J. (1992). Choice shift and group polarization: An analysis of the status of arguments and social decision schemes. Journal of Personality and Social Psychology, 62, 50-61.

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Reference: Henry, R. A. (1993). Group judgment accuracy: Reliability and validity of post discussion confidence judgments. Organizational Behavior and Human Decision Processes, 56, 11-27.

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Reference: Hall, D. T., Bowen, D., Lewicki, R. J., & Hall, F. (1975). Experiences in organizational management. Chicago: St. Clair Press.

27 Dormitory Rating Task

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33 Giving and Taking Task

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Reference: Crott, H. W., Szilvas, K., & Zuber, J. A. (1991). Group decision, choice shift, and polarization in consulting, political and local political scenarios: An experimental investigation and theoretical analysis. Organizational Behavior and Human Decision Processes, 49, 22-41.

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37 Human Relations Task

Reference: Mabry, E. A., & Attridge, M. D. (1990). Small group interaction and outcome correlates for structured and unstructured tasks. Small Group Research, 21, 315-332.

40 In-Basket No. 2 Task

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41 In-Basket No. 3 Task

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Reference: Bornstein, G. (1992). The free-rider problem in intergroup conflicts over step-level and continuous public goods. Journal of Personality and Social Psychology, 62, 597-606.

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Reference: Hornsby, J. S., Smith, B. N., & Gupta, J. N. D. (1994). The impact of decision-making methodology on job evaluation outcomes: A look at three consensus approaches. Group & Organization Management, 19, 112-128.

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54 Mystery Task No. 25

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References: Argote, L., Chester, A. I., Yovetich, N. Romero, A. A. (1995). Group learning curves: The effects of turnover and task complexity on group performance. Journal of Applied Social Psychology, 25, 512-529.

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Reference: Chen, X., & Komorita, S. S. (1994). The effects of communication and commitment in a public goods social dilemma. Organizational Behavior and Human Decision Processes, 60, 367-386.

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Reference: Valacich, J. S., Wheeler, B. C., Mennecke, B. E., & Wachter, R. (1995). The effects of numerical and logical group size on computer-mediated idea generation. Organizational Behavior and Human Decision Processes, 62, 318-329.

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Reference: Stewart, D. D., & Stasser, G. (1995). Expert role assignment and information sampling during collective recall and decision making. Journal of Personality and Social Psychology, 69, 619-628.

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Reference: Cox, T. H., Lobel, S. A., & McLeod P. L. (1991). Effects of ethnic group cultural differences on cooperative and competitive behavior on a group task. Academy of Management Journal, 34, 827-847.

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Reference: Davey, J. A., Schell, B. H., & Morrison, K. (1993). The Myers-Briggs personality indicator and its usefulness for problem solving by mining industry personnel. Group & Organization Management, 18, 50-65.

66 Quantitative Judgment Task

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68 Ranking Task

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73 Scrabble Task

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75 Securities Exchange Task

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Reference: Merron, K., Fisher, D., & Torbert, W. R. (1987). Meaning making and management action. Group & Organization Management, 12, 274-286.

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93 Alcohol Problem Task

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95 Arbitration of Promotion Grievance Task

Reference: McGrath, J.E. (1993). Introduction: The JEMCO workshop--Description of a longitudinal study. Small Group Research, 24, 285-306.

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97 Artificial Family Task

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98 Asch Conformity Task

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Reference: Bales, R. F., & Strodtbeck, F. L. (1951). Phases in group problem solving. Journal of Abnormal and Social Psychology, 46, 485-495.

101 Banduras's Social Learning Task

Reference: Bandura, A. (1962). Social learning through imitation. In M. R. Jones (Ed.), Nebraska symposium on motivation, Lincoln, NE: University of Nebraska Press.

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104 Byrne-Clore Similarity-Attraction Task

Reference: Byrne, D. (1971). The attraction paradigm. New York: Academic Press.

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Reference: Coch, L., & French, J.R., JR. (1948). Overcoming resistance to change. Human Relations, 1, 512-532.

109 Mock Jury Task

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116 Hall's Communication Strategy Training Task

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118 Illini Guides Task

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119 McGrath's Intellective Task 2

Reference: McGrath, J.E. (1993). Introduction: The JEMCO workshop- Description of a longitudinal study. Small Group Research, 24, 285-306.

120 McGrath's Investments and Mystery Tasks

Reference: McGrath, J.E. (1993). Introduction: The JEMCO workshop- Description of a longitudinal study. Small Group Research, 24, 285-306.

121 Kelley's Differential Status Task

Reference: Kelley, H. H. (1951). Communications in experimentally created hierarchies. Human Relations, 4, 39-56.

122 Latane-Darley Bystander Task

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123 Laughlin's Concept Attainment Task

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125 Lewin Group Discussion Task

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127 McGrath's Negotiation Task

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128 Milgram's Obedience Task

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129 Moromark Flextime Scheduling Task

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131 Newcomb's Acquaintance Process Task

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138 Schachter's Deviating Confederate Task

Reference: Schachter, S. (1951). Deviation, rejection and communication. Journal of Abnormal and Social Psychology, 46, 190-207.

139 Schachter's Fear-Arousal Affiliation Task

Reference: Schachter, S. (1959). The psychology of affiliation. Stanford, CA: Stanford University Press.

140 Schachter's Productivity-Norm Task

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141 Season Record Comparison of Competing Teams

Reference: Fiedler, F. E. (1954). Assumed similarity measures as predictors of team effectiveness. Journal of Abnormal and Social Psychology, 49, 381-388.

142 Sherif's Group Norm Task

Reference: Sherif, M. (1936). The psychology of social norms. New York: Harper.

143 Sherif's Intergroup Cooperation Task

Reference: Sherif, M. Harvey, O. J., White, B. J., Hood, W. R., & Sherif, C. W. (1961). Intergroup conflict and cooperation. Norman, OK: Institute of Group Relations.

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145 Social Facilitation Task

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146 Sommers' Personal Space Intrusion Task

Reference: Sommers, R. (1959). Studies in personal space. Sociometry, 22, 247-260.

147 Risky Shift Task

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Reference: Fiedler, F. E. (1954). Assumed similarity measures as predictors of team effectiveness. Journal of Abnormal and Social Psychology, 49, 381-388.

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151 The Vinacke-Arkoff Coalition Task

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152 Wicker's Overmanning-Undermanning Task

Reference: Wicker, A. W., & Kirmeyer, S. L. (1976). From church to laboratory national park. In S. Wapner, B. Cohen & B. Kaplan, (Eds.), Experiencing the environment. New York: Plenum Publishing Corporation.

153 Pierce's Invoice Task

Reference; McDonald-Pierce, L. G. (1986) Motivation and productivity in small, task-oriented groups (unpublished doctoral dissertation). Texas Tech University.

Note. Task numbers are arbitrary.

Table 8

Task Function Ratings

Task No.	Function: Information exchange A	B	C	Avg	Resource matching A	B	C	Avg	Coordination A	B	C	Avg	Error checking A	B	C	Avg
3	1	2	2	1.7	1	2	1	1.3	1	3	1	1.7	3	2	4	3.0
8	1	3	3	2.3	1	1	1	1.0	1	2	1	1.3	5	4	4	4.3
9	2	4	5	3.7	1	1	1	1.0	4	4	1	3.0	2	2	1	1.7
10	5	5	5	5.0	1	3	1	1.7	2	4	2	2.7	3	3	3	3.0
11	2	2	1	1.7	1	2	1	1.3	2	2	1	1.7	5	5	5	5.0
12	4	5	2	3.7	1	3	1	1.7	1	4	2	2.3	5	4	4	4.3
15	1	4	3	2.7	1	3	1	1.7	2	4	2	2.7	4	3	3	3.3
17	1	2	5	2.7	1	2	1	1.3	2	2	1	1.7	2	1	1	1.3
19	2	2	5	3.0	1	1	1	1.0	1	2	1	1.3	2	1	1	1.3
24	4	4	5	4.3	1	3	1	1.7	1	4	3	2.7	5	2	3	3.3
38	5	4	5	4.7	1	3	1	1.7	1	4	1	2.0	5	3	3	3.7
39	1	3	4	2.7	1	2	1	1.3	1	4	1	2.0	3	3	3	3.0
43	2	3	4	3.0	5	2	2	3.0	3	3	2	2.7	5	3	4	4.0
44	1	4	4	3.0	1	3	1	1.7	5	5	3	4.3	2	4	2	2.7
47	1	3	3	2.3	1	2	1	1.3	1	3	1	1.7	2	2	3	2.3
48	3	3	4	3.3	1	3	1	1.7	1	2	1	1.3	5	4	3	4.0
49	2	3	4	3.0	2	3	2	2.3	2	4	2	2.7	5	4	3	4.0
55	1	2	2	1.7	1	2	1	1.3	1	3	1	1.7	4	3	4	3.7
57	5	2	5	4.0	1	1	2	1.3	1	3	5	3.0	5	2	4	3.7
59	1	3	4	2.7	1	3	1	1.7	4	4	5	4.3	5	3	3	3.7
61	3	2	4	3.0	2	3	1	2.0	1	3	1	1.7	3	3	3	3.0
67	4	5	5	4.7	4	4	2	3.3	1	3	1	1.7	5	2	4	3.7
71	1	5	2	2.7	3	5	3	3.7	5	5	4	4.7	5	5	3	4.3
72	5	4	4	4.3	1	3	1	1.7	3	5	4	4.0	2	4	3	3.0
74	5	5	5	5.0	1	4	1	2.0	1	4	1	2.0	4	4	3	3.7
76	4	3	4	3.7	4	2	1	2.3	1	3	2	2.0	5	3	3	3.7
77	1	1	1	1.0	1	1	1	1.0	1	1	2	1.3	1	1	1	1.0
82	1	4	2	2.3	5	4	4	4.3	5	4	4	4.3	5	3	3	3.7
85	1	4	3	2.7	3	5	3	3.7	5	5	4	4.7	4	4	3	3.7
87	1	2	4	2.3	1	2	1	1.3	2	2	4	2.7	1	2	3	2.0
99	5	3	2	3.3	1	3	1	1.7	1	3	2	2.0	5	4	3	4.0
103	5	4	5	4.7	1	3	1	1.7	5	3	2	3.3	2	3	4	3.0
111	1	4	1	2.0	1	4	1	2.0	4	4	4	4.0	4	4	3	3.7
117	5	4	5	4.7	1	4	1	2.0	1	4	2	2.3	5	3	4	4.0
130	1	3	4	2.7	5	4	4	4.3	2	3	1	2.0	5	2	3	3.3
132	3	4	5	4.0	1	3	5	3.0	1	3	5	3.0	4	2	5	3.7
134	1	4	3	2.7	3	4	4	3.7	5	3	4	4.0	2	4	3	3.0
135	1	2	1	1.3	1	1	1	1.0	1	3	3	2.3	1	1	2	1.3
150	3	4	2	3.0	1	3	1	1.7	1	5	4	3.3	1	4	4	3.0

Note. A, B, and C identify the three raters.

It is apparent that agreement was still not high, but the press of time required that we proceed toward task development. The tasks that most exemplified each of the four functions were compiled into a preliminary task list (see Tables 9 and 10). As could be expected, some tasks loaded heavily on more than one function. The functions most easily distinguished were information exchange and error checking; resource matching was most problematic and not easily distinguishable from coordination according to the ratings. The Multi-Attribute Utility Analysis Task, although receiving a high score on resource matching, was not considered as a measure of

Table 9

Preliminary Task List Based Function Ratings

Information exchange	
10	Business Policy
74	Search for Oil
38[0]	Hidden Profile
11a	Information Exchange Rule Induction
67[1]	Quiz Task
103	Communication Networks
117[2]	Social Judgment
24	Desert Survival
72[3]	Scrabble No. 2
57	Old Guard Versus Young Turks
132	Nominal Group
Resource matching	
130	Multi-attribute Utility
82[4]	Structure Building
71[5]	Rolling Ball
85[6]	Tinker Toy
134[7]	Programmed Opponent
67[1]	Quiz Task
Coordination	
71[5]	Rolling Ball
85[6]	Tinker Toy
82[4]	Structure Building
44	Nonsummation
59	Planning Task
134[7]	Programmed Opponent
111	Deutsch's Trucking Game
72[3]	Scrabble No. 2
Error checking	
11	Error Checking Rule Induction
71[5]	Rolling Ball
12	Carter Racing
8	Behavioral Intentions
43	Integration Design
49	Judgment Policy
117[2]	Social Judgment
99	Back's Information-Discrepancy
48	Judge-Advisor
38[0]	Hidden Profile

Note. Identical tasks identified by common superscript.

Table 10

Ratings of Tasks in Preliminary List

Task No.	Information exchange A	B	C	Avg	Resource matching A	B	C	Avg	Coordination A	B	C	Avg	Error checking A	B	C	Avg
High information exchange tasks																
10	5	5	5	5.0	1	3	1	1.7	2	4	2	2.7	3	3	3	3.0
74	5	5	5	5.0	1	4	1	2.0	1	4	1	2.0	4	4	3	3.7
38	5	4	5	4.7	1	3	1	1.7	1	4	1	2.0	5	3	3	3.7
67	4	5	5	4.7	4	4	2	3.3	1	3	1	1.7	5	2	4	3.7
103	5	4	5	4.7	1	3	1	1.7	5	3	2	3.3	2	3	4	3.0
117	5	4	5	4.7	1	4	1	2.0	1	4	2	2.3	5	3	4	4.0
24	4	4	5	4.3	1	3	1	1.7	1	4	3	2.7	5	2	3	3.3
72	5	4	4	4.3	1	3	1	1.7	3	5	4	4.0	2	4	3	3.0
57	5	2	5	4.0	1	1	2	1.3	1	3	5	3.0	5	2	4	3.7
132	3	4	5	4.0	1	3	5	3.0	1	3	5	3.0	4	2	5	3.7
High resource matching tasks																
130	1	3	4	2.7	5	4	4	4.3	2	3	1	2.0	5	2	3	3.3
82	1	4	2	2.3	5	4	4	4.3	5	4	4	4.3	5	3	3	3.7
71	1	5	2	2.7	3	5	3	3.7	5	5	4	4.7	5	5	4	4.3
85	1	4	3	2.7	3	5	3	3.7	5	5	4	4.7	4	4	2	3.7
134	1	4	3	2.7	3	4	4	3.7	5	3	4	4.0	2	4	3	3.0
67	4	5	5	4.7	4	4	2	3.3	1	3	1	1.7	5	2	3	3.7
High coordination tasks																
71	1	5	2	2.7	3	5	3	3.7	5	5	4	4.7	5	5	3	4.3
85	1	4	3	2.7	3	5	3	3.7	5	5	4	4.7	4	4	3	3.7
82	1	4	2	2.3	5	4	4	4.3	5	4	4	4.3	5	3	3	3.7
44	1	4	4	3.0	1	3	1	1.7	5	5	3	4.3	2	4	2	2.7
59	1	3	4	2.7	1	3	1	1.7	4	4	5	4.3	5	3	3	3.7
134	1	4	3	2.7	3	4	4	3.7	5	3	4	4.0	2	4	3	3.0
111	1	4	1	2.0	1	4	1	2.0	4	4	4	4.0	4	4	3	3.7
72	5	4	4	4.3	1	3	1	1.7	3	5	4	4.0	2	4	3	3.0
High error checking tasks																
11	2	2	1	1.7	1	2	1	1.3	2	2	1	1.7	5	5	5	5.0
71	1	5	2	2.7	3	5	3	3.7	5	5	4	4.7	5	5	3	4.3
12	4	5	2	3.7	1	3	1	1.7	1	4	2	2.3	5	4	4	4.3
8	1	3	3	2.3	1	1	1	1.0	1	2	1	1.3	5	4	4	4.3
43	2	3	4	3.0	5	2	2	3.0	3	3	2	2.7	5	3	4	4.0
49	2	3	4	3.0	2	3	2	2.3	2	4	2	2.7	5	4	3	4.0
117	5	4	5	4.7	1	4	1	2.0	1	4	2	2.3	5	3	4	4.0
99	5	3	2	3.3	1	3	1	1.7	1	3	2	2.0	5	4	3	4.0
48	3	3	4	3.3	1	3	1	1.7	1	2	1	1.3	5	4	3	4.0
38	5	4	5	4.7	1	3	1	1.7	1	4	1	2.0	5	3	3	3.7

that function. Although task success depends on appropriately assigning team members to subtasks, based on team member resources, it does not include the means for assessing resources brought to the task. Thus, based mainly on their applicability to a battery compatible with the C2V test (e.g., tasks requiring physical performance were eliminated) but also on the patterns of the ratings and the potential to modify the tasks, a semifinal list of 13 tasks (see Table 11) was considered for implementation. One task on this list, numbered 11a, is a modification of task 11 that had recently been developed for the express purpose of studying information exchange in groups (McGlynn, Sutton, & Bliese, 1995).

Table 11

Semi-final Task List

	Information exchange
10	Business Policy
74	Search for Oil
38	Hidden Profile
11a	Information Exchange Rule Induction
67[1]	Quiz Task
	Resource matching
67[1]	Quiz Task
	Coordination
44	Nonsummation
59	Planning Task
111	Deutch's Trucking Game
72	Scrabble No. 2
	Error checking
11	Error Checking Rule Induction
12	Carter Racing
117	Social Judgment
99	Back's Information-Discrepancy

Note. Identical tasks identified by common superscript

DEVELOPMENT OF GROUP TASKS

A method section from a published article detailing an example of each task was copied for each team member, and a discussion of the implementation of each task as part of the task battery was led by a manager assigned to each task. One task was added to the depleted resource matching category (No. 153, Pierce's Invoice task). For each of the 14 tasks, talking papers that discussed potential obstacles to task development in either manual or digital versions were prepared by the managers. Nine tasks were selected for immediate implementation and five (Invoice Task, Planning, Trucking Game, Carter Racing, and Back's Discrepancy Task) were not implemented. Most of those in the latter group presented problems in terms of quantifiable dependent variables, their ability to withstand repeated administration, or the amount of work required to modify the task to make it suitable. As it was becoming apparent that the reliability of the C2V test results required as many replications as possible of each task, it seemed wise to expend effort in that direction instead of toward the development of a greater variety of tasks. At that point, we canceled the development of the tasks that had not been implemented. Later, the Business Policy task was eliminated on the grounds that, given time constraints, enough tasks tapping the information exchange function were already available.

Task development, including creating, gathering, or assembling stimulus materials, instructions, and test protocols involved frequent meetings of the entire research team for the purpose of exchanging information about work completed, cross-checking the work of the managers of the various tasks, and providing information about the test protocol and the C2V environment. Development of the manual and digital versions occurred nearly simultaneously as each task manager consulted with the programmer as specifications for the manual versions emerged. Thus, while the usual case was that the manual version was conceptualized and then converted into a digital version, in some instances, the exigencies of programming drove the development of specifications of the manual tasks. The final set of tasks was pared one more time when it was decided to drop the digital versions of the Scrabble Task and the Hidden Profile Task.

The most difficult problem in task development was the creation of a sufficient number of versions of each task. Almost without exception, the tasks that were finally developed involved some learning, not just about the nature of the task and the instructions for completing it, but also about the specific characteristics of the stimulus materials for a particular version. In scrabble, for example, one learns enough about a particular letter set in playing it so that a new letter set must be assigned for subsequent replications. Having asked subjects for a judgment based on particular information in either the Hidden Profile Task or the Social Judgment Task, it would not make sense to request a judgment based on the same information in a replication of the task.

Another issue involved determining the amount of time to assign to a replication of each task and coordinating those times with the test protocol. The research team's understanding, and in some cases direct experience, of each task, suggested optimal running times between 15 and 40 minutes. In the end, all tasks were assigned either 18 minutes or 30 minutes in order to accommodate an orderly test protocol. Table 12 presents the final list of tasks developed and the time allotted for each. In the following section, each of these tasks is described in detail.

Table 12

Final Task List and Allotted Times

Tasks by function		Time (min)
	Information exchange	
74	Search for Oil	18
38	Hidden Profile	30
11a	Information Exchange Rule Induction	30
	Resource matching	
67	Quiz Task	18
	Coordination	
44	Nonsummation	30
72	Scrabble 2	18
	Error checking	
11	Error Checking Rule Induction	30
117	Social Judgment	18

Search for Oil Task

Main Study Procedures

The goal of this task is to select areas of land that should be drilled for oil or natural gas. Land areas were represented on three 10-by-10 matrices via computer. Each matrix represented one aspect of the land: (a) surface hardness, (b) geological stratification, or (c) chemical composition. The three-member groups worked in face-to-face, screen-sharing, or audio conference situations. In the face-to-face situation, all three members worked at a single terminal, allowing each member to see all the available information. In the screen-sharing group, each member worked at a separate terminal but was able to see the information available to the other members. In the audio conference groups, members were only able to view one of the three maps and communicated

over intercoms. The decision to drill in a certain section of land was determined by a set of criteria. For example, if each matrix showed an "X" in a particular section of land, it was a good decision to drill that section. The area of land represented by the three matrices contained 25 oil sites. Using these procedures, the group members tried to maximize the amount of money they had. The groups started with $10,000 and lost $500 for a wrong recommendation to drill and received $1500 for an accurate recommendation.

Dependent Variables of Interest

These were accuracy (number of hits relative to the number of guesses), number of attempts per minute, and number of criteria used to make decisions. The criteria used were (a) random (decision based on a "feeling"), (b) single (decision based on information from one map), and (c) multiple (decision based on information from two or three maps).

References

Farmer, S. M., & Hyatt, C. W. (1994). Effects of task language demands and task complexity on computer-mediated work groups. Small Group Research, 25, 331-366.

Isenberg, D. J. (1981). Some effects of time-pressure on vertical structure and decision-making accuracy in small groups. Organizational Behavior and Human Performance, 27, 119-134.

Task Instructions

The task that you will be working on involves determining which land areas have the most potential for containing oil. Each of you is a scientist in a consulting firm and it is your job to select the areas of land that should be drilled for oil. Since drilling an exploratory well is very expensive, it is important that you make the most accurate decisions possible. Your goal in this task is to earn as much money for the oil company as you can. Each time you make an accurate decision, you will gain $1500. If you make a mistake, you will lose $500. Thus, it is important that you understand the following instructions.

Each of you has a map depicting a different feature of the land. These four features are the chemical composition of the land, surface hardness, surface mantle thickness, and geological stratification. Please note that information on all four of these features is needed in order to make an accurate drilling decision. These maps are actually 12-by-12 matrices that correspond to the master matrix that your executive officer (XO) has. Using the information from your individual maps, you will discuss the information on your maps, and the XO will

decide which areas of land to drill. Once he has determined where to drill, the XO will remove the tab covering that square on the master matrix. If an "X" appears behind the tab, it is an accurate decision. If no oil exists in that area, the space behind the tab will contain an "O." There are 33 correct drilling sites in all and can be located anywhere on the matrix.

On each of your individual maps, notice that there are three different characteristics of the land that must be considered: red, blue, and yellow. In order to find oil, certain combinations of these characteristics from all four maps must be present. As expert scientists, you are aware that every plot of land has a different combination of characteristics and land features that indicates the location of oil. Thus, the combination of characteristics will change each time you do this task. Your job will be made easier if you can decide what combination exists on the current plot of land.

We will now begin the task. Whenever he makes a decision to drill, the XO should remove the appropriate tab from the master matrix. Remember that you start this task with $10,000. You will gain $1500 for a correct decision and lose $500 for an incorrect drilling decision. The goal is to earn as much money as possible. The XO should keep track of the amount of money won and lost on each guess on the page marked "Group Earnings." You will continue working on this task until either 18 minutes pass or all 33 drilling sites have been located. Please begin.

Experimenter Instructions and Procedures

Object: To locate the 33 squares on a 12-by-12 matrix that meet the necessary conditions for oil.

Materials:

1. Master matrix indicating the correct oil locations

    a. Removable tabs, behind which are either an "X" indicating a hit or an "O" indicating a miss

    b. Master matrix given to the XO

2. Four individual maps containing one aspect of the land

    A. Chemical composition
    B. Surface hardness
    C. Surface mantle thickness
    D. Geological stratification

3. Individual maps with three characteristics (red, blue, and yellow) that describe the particular aspect of the land that the map illustrates

4. Earnings sheet—given to the XO

Procedure:

1. Subjects read instructions, which include a detailed description of the task.

2. Each subject is given one of the four individual maps, representing one aspect of the land.

3. Subjects are seated so that they can easily communicate with each other but in a way that prevents them from seeing the other three maps.

4. Subjects are instructed to begin working on the task. Work continues until 18 minutes have passed or until all 33 accurate choices have been identified.

Dependent Variables:

1. Accuracy, which is simply the number of hits relative to the number of guesses

2. Number of attempts made per minute

3. Total amount of money earned

Experimenter Instructions and Procedures:

1. Before the task begins:

    a. Ensure that all the tabs on the master map are in place
    b. Ensure you have all the necessary materials
    c. Check that the four individual maps correspond with the master map

2. During the task:

    a. Time the task (which should last no more than 18 minutes)
    b. Ensure that the XO is keeping a running tab of the group's earnings

3. After the task:

    a. Record the number of hits made
    b. Record the total number of guesses made

Procedures for Creating Search for Oil Maps

1. Make a 12-by-12 grid. (Overall dimensions of grid can be determined by the size of the computer screen or whatever material is being used for the manual version.)

2. Label the grid so that the individual squares in the matrix can easily be identified by group members. For example, the columns of the grid (moving from left to right across the top of the grid) could be identified by assigning letters beginning with an "A" for the first column and an "L" for the 12th column. The rows (moving from top to bottom on the grid) could be labeled with numbers with a "1" assigned to the first row and a "12" assigned to the 12th row. Using these labels would allow the members to identify the square in the upper left corner as square "A1." For example, a 4-by-4 matrix would look like this:

	A	B	C	D
1				
2				
3				
4				

3. Randomly select 33 squares within the matrix to be the locations that will contain oil. Caution should be used not to place these squares in any easily identifiable pattern.

4. Once the 33 squares have been selected, mark them on the master map by placing an "X" in that square. All other squares should contain an "O," indicating that no oil was found. All the squares should be covered in some way so that the location of the oil sites can only be discovered when that square is selected by the group. In the manual version, all the squares are covered by tabs, or simply blank pieces of paper, which are removed by a group member when a selection is made. For the digital version, it would be ideal if the appropriate symbol would appear when the appropriate labels are entered by the XO.

5. Using the 33 locations selected on the master map, you can create the four individual maps. These maps consist of a similar 12-by-12 matrix and should be labeled identically to the master map. Each map represents a different feature of the land (i.e., chemical composition, surface hardness, surface mantle thickness, and geological stratification). Each individual map, or feature of the land, contains information about three different characteristics. These characteristics

are ambiguous so not to give any clues about the location of oil. For example, the three characteristics could be represented by the colors red (R), blue (B), and yellow (Y).

For the group to discover oil, a certain combination of these characteristics must occur on a given square. Each group member must contribute to one part of the combination. For example, the combination might be three of a kind, so that the combinations RRRB, BBBY, YYYR, RBRR, BYBB, and YRYY could be possible solutions. For example, if Member No. 1 has red on square B3, Member No. 2 has blue on square B3, Member No. 3 has red on square B3, and Member No. 4 has red on square B3, oil would be found. If two of the members have red squares at this location and the other two have blue squares, no oil is found. This means that for each of the 33 squares selected on the master map, three of the members must have the same color on that square and one must have a different color. All the remaining squares must contain some other combination of colors so that the criteria of three of a kind are not met. (Please note that the three-of-a-kind criteria are just an example and that other combinations of colors should be used to make additional variations of the task.)

Hidden Profile Task

Main Study Procedures

In principle, pooling information permits a group decision that is more informed than the decisions of members acting individually. In particular, discussion can perform a corrective function when members individually have incomplete and biased information but collectively can assemble an unbiased picture of the relative merits of the decision alternatives. In this task, participants review evidence that supports three possible solutions to a decision that is to be made by the group. Two alternatives can be eliminated if all critical information is considered. Each group member receives a given number of facts, some of which are shared by all group members, some of which are shared by a subset of members, and some of which are not shared (see Table 13). These biased information sets will consist of facts that have either a positive or negative valence as well as irrelevant facts that have no bearing on the correct decision. The unique combination of these facts is designed to create a hidden profile. In a hidden profile, a superior decision alternative exists but its superiority is hidden from individual group members because they each have only a portion of information that supports this superior alternative. Participants are given 5 minutes to study their information sets and to make an individual decision, after which they cannot access the information again. They then have 20 minutes to discuss the alternatives and reach a group decision.

Table 13

Basic Information Distribution Scheme

	Participant No. 1	Participant No. 2	Participant No. 3	Participant No. 4
+ Not shared	+A1, +A2	+A3, +A4	+A5, +A6	+A7, +A8
- Shared	-A1, -A2, -A3, -A4	-A1, -A2, -A3, -A4	-A1, -A2, -A3, -A4	-A1, -A2, -A3, -A4
N Shared	NA1, NA2	NA1, NA2	NA1, NA2	NA1, NA2
+ Shared	+B1, +B2, +B3, +B4	+B1, +B2, +B3, +B4	+B1, +B2, +B3, +B4	+B1, +B2, +B3, +B4
- Shared	-B1	-B2	-B3	-B4
N Part Shared	NB1, NB2, NB3	NB1, NB2, NB3	NB4, NB5, NB6	NB4, NB5, NB6
+ Not shared	+C1	+C2	+C3	+C4
- Shared	-C1	-C2	-C3	-C4
N Shared	NC1, NC2, NC3, NC4, NC5, NC6	NC1, NC2, NC3, NC4, NC5, NC6	NC1, NC2, NC3, NC4, NC5, NC6	NC1, NC2, NC3, NC4, NC5, NC6

+ Shared: Indicates the positive facts that are shared.
- Shared: Indicates the negative facts that are shared.
+ Not shared: Indicates the positive facts that are unshared.
- Not shared: Indicates the negative facts that are unshared.
N Shared: Indicates the neutral facts that are shared.
N Part Shared: Indicates the neutral facts that are partially shared.

Each participant looks at 24 total facts.
Alternative A has 14 total facts.
Alternative B has 14 total facts.
Alternative C has 14 total facts.

Dependent Variables of Interest

These are the degree to which a task set has an impact on pre-discussion opinion; the effect of pre-discussion information distribution on group decision; and recall of critical facts before and after discussion.

References

Stasser, G, & Stewart D. (1992). Discovery of hidden profiles by decision-making groups: Solving a problem versus making a judgment. Journal of Personality and Social Psychology, 63, 426-434.

Stasser, G., & Titus, W. (1985). Pooling of unshared information in group decision making: Biased information sampling during discussion. Journal of Personality and Social Psychology, 48, 1467-1478.

Task Instructions

This decision-making task is divided into two parts. The first part will be devoted to reviewing all the important information about the decision to be made and will take 7 minutes. Each person will receive a set of facts pertaining to each of three possible solutions to a given problem. Members of decision-making groups rarely have identical sets of information about available alternatives, and in the interest of realism, members of this group will not receive exactly the same information as their fellow group members do. Please note that you will not be receiving conflicting information. At the end of the 7-minute review period, please put your fact sheets back into their original envelopes. You will not be allowed to look at your fact sheets once the discussion phase has begun. Each group member will record their pre-discussion alternative choice on the form provided.

The second part will be devoted to trying to reach a decision about which is the correct alternative to choose and will take a maximum of 23 minutes. During the first part of your discussion, avoid stating a preference or indicating which alternative you personally think is best. Rather, try to recall and review all the relevant and important information. Only when you all feel that you have discussed all the important information about each alternative should you proceed to the second part of your discussion.

During the second part of the discussion, you should try to reach a decision about which alternative is the demonstrably correct solution to the stated problem. Of course, during this decision-making phase, you are free to express your preference at any time. Once the XO has reached a decision about the correct solution, he will write the alternative chosen on the form provided.

1. Individually, participants read a problem statement that calls for a choice to be made among three decision alternatives (A, B, and C). In this 5-minute period, they also review eight facts per alternative. There are 28 total facts that either support or discredit the three alternatives:

a. Positive facts: eight for choice A, four for choice B, four for choice C,
b. Negative facts: four each for choices A, B, and C, or
c. Irrelevant facts: two for choice A, six for choice B, six for choice C

If all 28 facts are considered, B and C can be eliminated as viable alternatives, and A is shown to be the best solution to the problem.

2. Fact distribution:

a. Not shared

(1) Two facts per participant indicating choice A
(2) One fact per participant indicating choice C
(3) One fact per participant discrediting choice B
(4) One fact per participant discrediting choice C

b. Shared

(1) Four facts indicating choice B
(2) Four facts discrediting choice A

3. Individuals privately indicate their choice.

4. Participants discuss the alternatives in a group setting and are given 20 minutes to select the best alternative. However, discussion can end when a unanimous decision is reached.

Primary dependent variable (DV): Accuracy of post-discussion solution (no additional materials required).

Secondary DVs: (Requires videotape of group discussion)

a. Number of critical facts introduced into discussion
b. Number of times critical facts are repeated (i.e., reconsideration)
c. Number of non-critical facts mentioned
d. Percent of time devoted to critical items (i.e., maintaining focus)

Example (Training) Hidden Profile Task

Variation No.	Variation Name	Correct Alternative
T1	Fire Extinguisher	A

The problem: You are part of the fire safety committee and must decide about the purchase of fire extinguishers. The Underwriters' Laboratories (UL) provided you with the following classifications to help you with your decision: (1) Class A fires are from ordinary combustible materials, such as paper, wood, fabric, rubber, and plastic; (2) Class B fires are those caused by flammable liquids—oil, grease, gasoline, paints, or cleaning solvents; and (3) Class C fires involve an electrical component—an appliance, television, computer, or wiring. Extinguishers are also rated for the relative size of each type of fire they can handle. An "A" listing, for example, means the unit has twice the fire-fighting capability of a "1" rating. (C is not rated numerically; that designation simply means that the extinguishing agent is not electrically conductive.) Committee members have also obtained numerous facts independently to help with the decision.

1. This unit is a dry chemical unit, rated 2A:10B:C.
2. This is the best selling brand in the market.
3. This is the best selling model in the consumer market.
4. This unit meets U.S. Coast Guard approval.
5. This unit comes equipped with a bracket for wall mounting.
6. This model has an easy-to-hold handle.
7. This model has a push-to-test button that indicates whether the unit is fully charged.
8. This model has white "decorator" styling (unlike the bright red of the other alternatives).
9. This is the highest priced unit on the market.
10. This is a rather large unit, which makes it difficult to carry and use effectively.
11. The chemical used in this unit has a noxious odor.
12. The chemical in this unit is toxic to small animals.
13. This unit comes equipped with a bracket for wall or ceiling mounting.
14. A dial-type pressure gauge shows at a glance whether the unit is fully charged.
15. This is a very popular model according to Consumer Digest.
16. This unit is a dry chemical unit, rated 1A:10B:C
17. This unit has been reported to become very warm to the touch in conditions of extreme heat.
18. The paint on this unit is not heat resistant.
19. This unit has a hair trigger and may spray when bumped.
20. This unit is difficult to mount.
21. This model has an easy-to-push trigger.
22. The model meets Department of Transportation (DOT) requirements.
23. This model is a sodium bicarbonate dry chemical unit, rated 2B:C.
24. This unit's wall-mount bracket is designed for quick release.
25. The paint on this unit may contain lead.
26. The mounting bracket is made of inexpensive plastic.
27. This unit has a small chemical storage capacity.
28. Skin irritation may result if contact is made with the chemical compound in this unit.
29. The company that manufactures this model also makes bug spray.
30. This model comes with a magnet to put on your refrigerator.
31. The information you received about this unit was printed in two different languages.
32. The ad for this unit shows a Dalmatian sleeping under the extinguisher mounted on the wall.

33. The manufacturer of this unit is located in Wyoming.
34. The promotional description of this unit is very confusing.
35. The sales person you talked to about this unit is enrolled in a computer course.
36. The store where you would buy this unit is located five blocks away from the mall.
37. This model was displayed next to picnic tables in the store.
38. The store where this unit is sold is open 9 a.m. to 6 p.m.
39. The instructions on this unit are printed in blue ink.
40. The mounting bracket on this unit is black.
41. The sales person you spoke with about this unit had to ask a supervisor what the price was.
42. When calling for more information about this model, one of the committee members was "put on hold" for a brief time.
43. This unit comes in a well-marked box.

Experimenter Instructions and Procedures

Step 1. Place the fact sheets for the version you are administering in individual 8.5- by 11-inch envelopes and label those envelopes "Team Member No. 1," "Team Member No. 2," "Team Member No. 3," and "Team Member No. 4."

Step 2. Enter the appropriate information on participants' Part I and Part II instruction-response sheets. This includes the test day (options are 1-10), cell (options are 1-4), version (options are 1-14), team member number (options are 1-4 with 1 being the XO), and team number (options are 1-8).

Step 3. Give each team member a copy of the participant instructions and answer procedural questions after the instructions have been read by all participants.

Step 4. Give each team member the appropriate Part I pre-discussion instruction-response sheet and tell him or her to begin Part I. Instruct the team members that they have 7 minutes to privately review their individual facts sheets and make their pre-discussion alternative selection.

Step 5. After the 7 minutes have expired and all participants have written their alternative preference in the designated space, pick up the Part I instruction-response sheets, the individual fact sheets, and the envelopes. Distribute the Part II instruction-response sheets. Ensure that Team Member No. 1 receives the instructions labeled "XO Instructions."

Step 6. Instruct the participants that they have 23 minutes to discuss the problem, after which the XO is to indicate his selection of best solution in the designated space. Remind the participants that during the first part of the discussion, they should avoid stating a preference or indicating which alternative they personally think is best. Rather, they should try

to recall and review all the relevant and important information. Only when they all feel that they have discussed all the important information about each alternative should they proceed to the second part of the discussion. During the second part of the discussion, they should try to reach a decision about which alternative is the best solution to the stated problem. During this decision-making phase, they are free to express their preferences at any time.

Step 7. When the 23 minutes have expired, stop the experiment and ensure that the XO has indicated his post-discussion alternative preference in the designated space. Note. The discussion can end earlier if the XO has made a decision and written that decision in the space provided.

Table 14 presents a listing of the versions of the hidden profile tasks created to support the C2V limited user test (LUT).

Table 14

Hidden Profile Tasks

Variation No.	Variation name
1	Airline
2	Snow removal
3	Clock radio
4	House
5	Rent to own
6	Health club
7	Attorney
8	Vacation
9	Washing machine
10	Car
11	Phone
12	Newspaper
13	Air conditioning
14	Refrigerator

Information Exchange Rule Induction Task

Main Study Procedures

The task is a collective induction of a rule that partitions a standard deck of 52 playing cards with four suits of 13 cards into evidence that is consistent or inconsistent with the rule. The rule could be based on any combination of numerical and logical operations on suit and number. (See Table 15 for rules used during the C2V LUT.) Each individual has his own display of cards not visible to other group members, and play begins with the viewing of one card (the same card for everyone) that is consistent with the rule. Members first propose their own hypothesis as to what the rule is. Individually, they next pick any card from several decks available to them with the instruction that they are to choose a card that they think will give them the most information. After being informed whether the chosen card fits the rule in each individual display, the group is given a limited time to discuss the problem and to propose a group hypothesis. This procedure continues for 10 trials.

Dependent Variables of Interest

These include plausibility of hypotheses based on card displays; quantity and quality of information exchange; quantity and effectiveness of error checking; social combination processes (process by which groups resolve disagreement—voting, turn taking, demonstration, generation of a new emergent group response; decision process-majority, proportionality); and group versus individual performance.

Reference

Laughlin, P. R., VanderStoep, S. W., & Hollingshead, A. B. (1991). Collective versus individual induction: Recognition of truth, rejection of error, and collective information processing. Journal of Personality and Social Psychology, 61, 50-67.

Task Instructions

This task involves cooperative problem solving. You are not competing with each other in any way; the object is to solve a problem by cooperating with each other. First, I will explain the kind of problem you will be solving and then I will explain how you will be working on it.

Table 15

Rules and Starting Cards

Information exchange (IE) rule induction task		
Version	Rule	Starting card
1	3 < card < Q	8S
2	CCDD	8C
3	SHHH	7S
4	card >= 8	8D
5	Cards increase by 2 then decrease by 4 (ex. 787654565432)	7H
6	All even	8H
7	All odd and alternating black and red	7C
8	SSSHH	8S
9	8 <= card < Q	8D
10	CHCC	8C
11	RBRB	8H
12	card < 10	8C
13	6 <card <J	7D
14	Odd red	7D
15	EEOO	8D
16	DCDC	8D
17	OEOE	7C
18	card > 6	8S
19	DDDC	8D
20	BRBB	8C
21	BRRR	8S
22	SSDDD	7S
23	OEEE	7H

C=club D=diamond H=heart S=spade B=black cards R=red cards O=odd cards E=even cards A=ace K=king Q=queen J=jack 1-10 = cards 1-10 (<)= less than (<=) =less than or equal to (>) = greater than (>=) = greater than or equal to

The object is to figure out an arbitrary rule that divides an ordinary deck of playing cards into cards that fit and cards that do not fit the rule. Aces have the value 1, deuces 2, threes 3, up to Jacks 11, Queens 12, and Kings 13. OK?

Now, the rule can be based on any characteristic of the cards. For example, the rule might be "diamonds" so that any card that is a diamond would fit the rule and all other cards would not fit the rule.

(On the master playing board, demonstrate the rule by playing 8D—the initial card—, JD, JC, 5H, 4D from the pre-arranged deck while asking the participants "does this fit the rule or not?" for each card after the initial card.) While playing the cards, say

"Notice how I place the cards in a display with cards that fit the rule across the top row to the right of the last card played and cards that do not fit the rule down the columns under the last card played. One more thing: rules are based on the face side of the cards ONLY and NOT on the back side of the cards (indicate back of cards)."

(Ensure that everyone understands the rule and how the cards are played.)

"Or the rule might be 'even diamonds'."

(Demonstrate the rule as above by playing 6D, 6C, QD, 2S).

"Or the rule might be 'even diamonds or clubs above the six'."

(Demonstrate the rule as above by playing QC, 9S, 8H, 10D, AC).

"Or the rule might be something like 'odd spades alternate with even clubs'."

(Demonstrate the rule as above by playing 3S, 4H, 4C, QH, JS).

"So, all those are just examples of what the rule might be. The rule can be anything. It might be based on number, suit, color, a pattern like alternation, or any combination of any characteristics. So you see the rule might be pretty simple or it might be pretty complex. Are there any questions about what I mean by a rule?"

(Answer any questions as much as possible by repeating relevant parts of the instructions).

"In the problem you will be solving, I will start you with one card that does fit the rule, then you try to decide what the rule is by picking any card you want from the decks in front of you, and I will tell you whether they follow the rule. If a card you pick fits the rule, I will place it across the top row; otherwise, I will place it below the last card played just like we did before. Any questions so far?"

(Ensure that everyone understands).

Have all participants PRINT their names on the "Individual Hypothesis" sheet.

Give the XO the "Hypothesis After Discussion" sheet.

"For this task, we are going to have all four of you cooperate in solving one of these problems. Each one of you will have his or her own display of cards, but you will all be working on the same problem with the same rule and the idea is to solve the problem by working together as a cooperative group. The XO will write the answers on the sheet labeled 'Hypothesis After Discussion'."

"We want you to work together, but do not look at the cards being played by other group members. Also, please do not talk to each other except during the discussion time, and do not write anything except your hypothesis."

"I will start all of you with the same first card that fits the rule. Write that card on your Individual Hypothesis sheet (indicate where). Of course, the first card will fit a lot of rules. The first step is to write an hypothesis or guess about what the rule might be. That is, form your own hypothesis before any discussion and write it on your individual sheet where it says hypothesis."

"When you write your hypothesis, use the abbreviations D for diamonds, C for clubs, H for hearts, S for spades, A for ace, J for jack, Q for queen, K for king, and ensure that it is written so we can understand exactly what you meant."

"After you write your hypothesis, I will signal you to begin discussing the problem to select a single hypothesis. The single hypothesis is the one the XO chooses after group discussion. The XO should write the hypothesis on the 'Hypothesis After Discussion' sheet (indicate where)."

"After that, you each will choose any one of the 52 cards from the decks in front of you to test your hypothesis. You can pick any one of the cards from the decks in front of you. Place the card selected in the lower left corner of the playing board. I will let you know if it fits the rule by putting it in the display just like we did before. Then you write what card you played on your individual sheet (indicate where). Choose the card that you think will give you the most information. There are several decks, so you can play the same card more than once."

"Then the process starts all over again with each of you: writing an individual hypothesis, discussing the problem, choosing a single hypothesis, and playing a card, and so forth until 12 cards have been played. Then you will make your final hypotheses. The final single hypothesis will be your final answer to the problem. Any questions?"

(For each trial, ensure that card choices, individual hypotheses, and group hypotheses are written and legible.)

From the Confidential rule sheet, determine what the rule is for the version being played. Find the designated starting card for each participant (from one of each player's decks), and place that card in the upper left corner of the playing board. Participants will begin play by writing their individual hypotheses.

Supervise the procedure by letting participants know when they may begin discussion of each trial.

Quiz Task

Main Study Procedures

Groups were presented with 20 multiple choice questions about topics such as geography, entertainment, trivia, sports, and vocabulary (see Table 16). After answering all the questions, groups ranked the items according to the relative amount of confidence they had in each answer. Ultimately, the groups had a rating scale ranging from 20 to 1, with 20 indicating the answer in which they had the most confidence and 1 indicating the answer in which they had the least confidence. Subjects worked individually or in groups of two, five, or ten members.

Dependent Variables of Interest

These include the sum of the points assigned to items that were answered correctly, number of correct answers, and percent of points possible (calculated by dividing the overall score by the number of points possible if all the correct items were ranked higher than the incorrect items).

Table 16

Sample Questions and Answers for Quiz Task

1. What president's executive clemency order got Patty Hearst out of prison?	Jimmy Carter's
2. What Apache chief hawked souvenirs at the Louisiana Purchase Exposition?	Geronimo
3. Which of the Collins sisters was expelled from school for selling her sexually spiced limericks and waving at a local flasher?	Jackie Collins
4. What horror novelist noted: "Fear and death are two of the human constants"?	Steven King
5. What was H.M. Stanley referring to in his 1878 book "The Dark Continent"?	Africa
6. What movie title was also Barbra Streisand's first Number 1 song?	The Way We Were
7. What actor put on 30 pounds and a big scar to play Al Capone in the movie "The Untouchables"?	Robert DeNiro
8. What TV soundtrack album topped the charts for 11 weeks in 1985, beating 1959's Music from Peter Gunn by a week?	Miami Vice
9. What was the first American movie to center around Kung Fu?	Enter the Dragon
10. Who's the captain of the Pequod in Melville's Moby Dick?	Captain Ahab
11. What nation saw Juan Peron provide 10,000 blank passports for Nazis after WW II?	Argentina
12. Who was Latin America's first female vice president?	Isabel Peron
13. What 1964 coin did many Americans tend to save rather than spend?	The Kennedy half-dollar
14. What Russian leader blew the whistle on Joseph Stalin's crimes?	Nikita Khrushchev
15. What general wed Paris socialite Josephine de Beauharnais in 1796?	Napoleon Bonaparte
16. Who was the first major league pitcher to strike out 4,000 batters by 1985, and 5,000 by 4 years later?	Nolan Ryan
17. What's the only part of a football field to have protective padding?	Goal posts
18. Who was the first man to coach the Chicago Bears to a Super bowl win?	Mike Ditka
19. What's the occupation of Nintendo's Super Mario?	Plumber
20. What brand of soy sauce was introduced at Noda, Japan in 1630?	Kikkoman
21. What Italian entree's name translates literally as "cooking pot"?	Lasagna
22. What's the male element of the yang and yin system derived by Chinese emperor Fu Hsi?	Yang
23. What 1969 event prompted Richard Nixon to say: "This is the greatest week since the beginning of the world, the creation"?	the lunar landing

Table 16 (continued)

24. What do radio and TV stations east of the Mississippi begin their call signs with?	W
25. What type of implant has added 60,000 pounds per year to the total weight of Americans?	breast implants
26. Where was the transistor invented—Britain, Japan, or the U.S.?	the U.S.
27. Who's the world's least cooperative female autograph giver, according to The Autograph Collector's Magazine?	Barbra Streisand
28. What wake-up call did General Westmoreland do away with in hopes of drawing more recruits in 1970?	Reveille

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Reference

Littlepage, G. E. & Silbiger, H. (1992). Recognition of expertise in decision-making groups: Effects of group size and participation patterns. Small Group Research, 23, 344-355.

Task Instructions

In the following task, your group will be asked to answer 20 questions covering a variety of topics. You should discuss each question in an attempt to derive the correct answer. Once the XO chooses the best answer to the question, each one of you should write that answer in the appropriate space on your answer sheet (in the blank to the right of the number corresponding to the question). You will have 15 minutes to complete this portion of the task.

After all 20 questions have been answered, you will be asked to rate the amount of confidence the group has in each answer. Give the confidence rating in the form of a percentage so that a question you know is right receives a score of 100% and one that you absolutely know is wrong receives a rating of 0%. You will be given 3 minutes to complete this portion of the task. Please do not make any confidence ratings until you have completed the first part of the task. Please begin now by answering each of the following questions.

After all 20 questions have been answered...

Now, we want you to rate the amount of confidence you have in each of the answers. Discuss the level of group confidence in each answer. Once the XO has determined what rating should be assigned to the question, everyone should write that rating on the appropriate space on your answer sheet (in the blank to the left of the number corresponding to

the question). Just to remind you, you will have 3 minutes to complete this portion of the task. Please begin.

Experimenter Instructions and Procedures

Object: To correctly identify expertise within a group and correctly assess the accuracy of answers

Materials:

1. Four copies of the same 20-item quiz

2. Four answer sheets

3. Quiz Task Instructions and Rating Instructions

Procedure:

1. Groups read instructions concerning the method to be used in answering the questions.

2. After all questions have been answered or 15 minutes have passed, the instructions for rating the confidence the group has for each answer are read.

3. Groups rate their answers until all questions have been rated or 3 minutes have passed.

Dependent Variables:

1. Sum of the points assigned to items that were answered correctly

2. Number of correct answers

3. Percent of points possible (calculated by dividing the overall score by the number of points possible if all the correct items are rated higher than the incorrect items)

Experimenter Instructions and Procedures:

1. Ensure that each member has a copy of the same quiz.

2. Ensure that each member has an answer sheet.

3. Time the task so that 15 minutes are given to answer the questions and 3 minutes are given to rate the answers.

Nonsummation Task

Main Study Procedures

Individuals are assigned to groups. Each subject in each group is given a different combination of 27 letters determined to be of equal difficulty by an independent pretest sample. Each individual then uses the series of letters to form words of three or more letters. These words are placed on an individual word list. Each group then takes these words and incorporates them into sentences. Each sentence has to contain at least one word from each group member, with no upper limit to the number of words in each sentence. No sequential task order is specified; however, two restrictions are operable. First, once a letter is used by an individual in a group sentence, that letter cannot be used again. However, an individual can change the words on his or her list to help the group's sentence completion. Second, individuals are allowed to give letters from their lists to other group members, with the stipulation that the subsequent word is not added to either member's word list. The letters contributed are subtracted from the individual's word list. A practice trial is conducted before the experimental session.

Groups can be assigned to one of six goals: (a) no assigned goal, that is "do your best"; (b) an egocentric individual goal (which maximizes individual performance); (c) a group goal (construct five sentences with at least one three-letter word from each group member); (d) a combined egocentric and group goal; (e) a group centric goal (maximizes individual contributions to group performance); or (f) a group centric and group goal in combination.

Dependent Variables of Interest

The three main measures are (a) individual performance (the number of three-letter words listed on the subject's word list), (b) individual contribution to the group (the number of letters the individual contributes to the group's sentences), and (c) group performance (the number of sentences with at least one three-letter word contributed by each group member). Additional measures include the degree to which each member is committed to his or her own or the group's performance, whether the group's strategy is cooperative or competitive, assessment of individual strategies, and individual ability level.

Reference:

Crown, D.F., & Rosse, J.G. (1995). Yours, mine, and ours: Facilitating group productivity through the integration of individual and group goals. Organizational Behavior and Human Decision Processes, 64 (2), 138-150.

Task Instructions

You will receive a set of letters from which you will form an initial list of words. You and the other members of your team will then combine the words to form sentences. To make the sentence construction easier, you may swap (if you give a letter, you must get one in return) letters with other team members to form additional words. The XO will determine when a proposed sentence is valid and will then write it. Once a sentence is completed, the team will then construct another sentence, swapping letters as needed. The object of the task is to make as many sentences as possible. The following restrictions must be observed:

1. If a particular letter is used in a word and that word is used in a sentence, that letter or word cannot be used again.

2. A word that was initially formed can be changed to another word to facilitate sentence construction.

3. When a letter is given to another station, it is removed from the giver's letter list or word list and added to the receiver's letter list or word list. In return, the receiver must also give a letter to the same sender.

On the next page is the set of letters from which you will make your initial word list. Based on the letters you have, print below the letter set as many words as you can think of that contain three or more letters. Once you have used a letter in a word, put a line through the letter so you will not use it again. You can only use a particular letter once. Once you complete your initial word list, transfer your initial words to the word page, and transfer your unused letters to the unused letter page. Then finish reading the instructions on the unused letter page. You will have 5 minutes to do this. Begin. Print each word formed on the word lines (W) below. On the letter lines (L) place an "O" (for own) below each letter in the words you transferred. Since you will be swapping letters, the letter lines help you to keep track of which station you sent letters to and which stations you get letters from. Put only one letter on each dash mark. When you are finished transferring words, go to the unused letter page.

W _ _ _ _ _ _ _ _ _ _ W _ _ _ _ _ _ _ _ _ _
L _ _ _ _ _ _ _ _ _ _ L _ _ _ _ _ _ _ _ _ _
used in a sentence? yes used in a sentence? Yes

W _ _ _ _ _ _ _ _ _ _ W _ _ _ _ _ _ _ _ _ _
L _ _ _ _ _ _ _ _ _ _ L _ _ _ _ _ _ _ _ _ _
used in a sentence? yes used in a sentence? yes

etc....

Transfer your unused letters to the unused letter line (U). The swapped letter line (L) will help you keep track of who you exchange letters with. For example, if you exchange your first letter with another station, place the number of that station directly below the letter on the dash and draw a line through the letter. If you receive a letter but cannot use it in a word immediately, write it on the U line and the station you got the letter from on the L line.

U _ _ _ _ _ _ _ _ _ _ _ _ _ _ _

L _ _ _ _ _ _ _ _ _ _ _ _ _ _ _

When sentence construction begins, you have the option of swapping unused letters and letters you previously used to make words.

If you exchange a letter with another station which you have already used to form a word, you will need to erase the "O" and clearly write in the number of the station to which you have given the letter. Also, you must draw a line through the letter you have given away. If you decide to use a letter or letters from a word you have already formed but you now want to create a new word, write the new word on a clear "W" line, draw a line through the letter of the old word and a line through the originating station number, and write on the L line where you got the letters from to form the new word. For example, under the new word, write an "O" under letters that were originally yours and write the originating station numbers of any other letters that are used.

Shortly, the sentence construction part of this task will begin. When you use a word in a sentence, circle the "yes" just below the word. You may not use that word again in another sentence.

You have 25 minutes to make as many sentences as possible.

XO Sentence Log:

When the sentence construction period begins, write below on the spaces provided each sentence your team makes. Write each word in the sentence separately on each long line and register the station that contributed that word to the sentence on the short line. A valid sentence must have at least one word contributed by each team member, and each word must have three or more letters.

You need to construct as many valid sentences as possible.

1. _____ _____ _____ _____ _____

___ ___ ___ ___ ___

2. _____ _____ _____ _____ _____

___ ___ ___ ___ ___

etc.

Experimenter Instructions and Procedures

1. All subjects but the XO should be given a booklet that contains pages for word formation.

2. The XO should be given a booklet that contains pages for word formation and sentence construction.

3. The task involves two phases. The first phase is individual word formation pages. The second phase is group sentence construction pages. Allow 5 minutes for individual word formation phase and 25 minutes for group sentence construction phase.

Scrabble Task

Task Instructions

The goals of this task are to form as many words as possible, to use as many letters in those words as possible, and to earn as many points as possible for words placed on a matrix. In this task, each letter of the alphabet has been assigned a point value ranging from one to 10. Each of you will receive a set of 40 letters. In addition, you will receive a sheet that indicates the point value of all the letters in the alphabet. Using the letters in the letter sets and keeping in mind the point values of the various letters, group members will create several words. These words will be placed on matrices in an interlocking fashion. By this we mean that each word that is placed on a matrix must cross, or share a letter with, another word currently on the matrix. For example, assume that the word "advance" currently appears on the matrix. Next, assume that you have the letters M, S, T, E, and R in your letter set. You can create the word "master" by placing your letters on the matrix as illustrated below:

```
M
ADVANCE
S
T
E
R
```

The following rules must be followed when words are placed onto the matrix:

1. All words must be connected to a word currently on the board in some way.

2. All words on the board must be English words that are in a dictionary.

3. No proper nouns, abbreviations, or words requiring hyphens or apostrophes are allowed.

4. You may add to words already on the matrix, provided that the result is also an appropriate word. For example, if you had the letters S, A, C, and K, you could place the word "sack" at the end of the word "advance" in the diagram above to form the word "advances." The matrix would then look like this:

```
M
ADVANCES
S       A
T       C
E       K
R
```

5. All letters adjacent to one another must form a word. You cannot place a new word on the matrix if adjacent letters somewhere on the matrix do not form a word. For example, suppose you have the letters M and N and place them on the board as follows:

The letters EM in this example do not form a word; therefore, the word "man" cannot be created at this location on the matrix.

```
M
ADVANCES
S     MAN
T       C
E       K
R
```

6. Words can be placed either horizontally or vertically, as in the examples given. No words formed diagonally are allowed.

Each of you will be given a matrix with a seven-letter word in the center of it. All four of these matrices are identical. Each word that is played by an individual member must also be placed on the remaining three matrices. Thus, when any member places a word on his or her matrix, that member must announce where the word is being placed and the spelling of that word. For example, if you were the member who placed the word "sack" in the recent example, you would say something like, "I am placing the word "sack," S-A-C-K, at the end of the word "advance" to make "advances." Other group members should confirm this location if they are unsure what the person meant. The XO's matrix will be the matrix used in assessing group performance, so extra care should be taken by the XO to place new words in the appropriate place on his matrix.

The goals of this task are to

a. form as many words as possible,
b. use as many letters in those words as possible, and
c. earn as many points as possible in the words placed on the matrix.

Therefore, it is important to consider the point value of each letter when making words and then placing them on the matrix.

In order to facilitate the forming of words, you may exchange letters with other group members. Each time you receive a letter from another member, however, you must give up a letter from your letter set. Indicate an exchange of letters by placing an "X" through the letter you gave to the other member and writing the letter you received in its place. Again, the exchange of letters should occur in order to maximize the point value of each word placed on the matrix.

There is no need to take turns in placing the words on the matrix. Since you will only have 4 minutes to place words on the matrix in each trial, it will be to your benefit to place words on the matrix as quickly as possible. Once again, keep in mind that the total point value of the letters actually placed on the matrix will determine your group's overall performance of this task. Thus, it is important that you discuss the words that are being placed on the board and that you exchange letters with other group members to increase the number of words that can be formed. The XO should remove a word from the board if he feels that more points could be earned with another word or if one of the rules of the task has been violated.

The entire task lasts 16 minutes and consists of four 4-minute trials. A different seven-letter word will be placed in the center of the matrices at the beginning of each trial, and each member will have a new letter set at the beginning of each trial. On the pages

containing the letter sets, you will find that the bottom part of the page is blank. You might find it useful to use this space to write words that can be formed from your letter set. When instructed to do so, you may turn to the following page and look at your first letter set and the matrix titled "Trial 1." Do not look at any other pages in your packet at this time. When the experimenter indicates that the first 4-minute session is finished, wait for him to begin the next trial. When the experimenter announces the beginning of the next trial, turn to the next letter set and the matrix titled "Trial 2." Repeat this process until the 16-minute task has been completed. The XO should confirm at the beginning of each 4-minute trial that the same seven-letter word appears on all four matrices before the task continues. (If the same word does not appear, the group members should change the word in that location to match the word on the XO's matrix.)

Point Values

A=1	F=4	K=5	P=3	U=1
B=3	G=2	L=1	Q=10	V=4
C=3	H=4	M=3	R=1	W=4
D=2	I=4	N=1	S=1	X=8
E=1	J=8	O=1	T=1	Y=4
				Z=10

Dependent Variables of Interest

These are commitment to the group goal, group cohesion, group performance, and group goal: variations include goal type (assigned, group set), and degree of difficulty of the assigned goals.

Experimenter Instructions and Procedures

Preparation:

1. Each member needs one copy of the "Point Values" sheet (total of four copies).

2. Four copies of the matrices for each trial need to be made (total of 16 copies).

The matrix to be used in each trial for the 14 versions of the task is given in Table 17. (The word that is placed in the center of the matrix is used for identification.)

Table 17

Matrix for Scrabble Task

Version	Trial 1	Trial 2	Trial 3	Trial 4
1	Program	Station	Speaker	Digital
2	Station	Program	Digital	Speaker
3	Speaker	Digital	Program	Station
4	Digital	Speaker	Station	Program
5	Program	Station	Speaker	Digital
6	Station	Program	Digital	Speaker
7	Speaker	Digital	Program	Station
8	Digital	Speaker	Station	Program
9	Program	Station	Speaker	Digital
10	Station	Program	Digital	Speaker
11	Speaker	Digital	Program	Station
12	Digital	Speaker	Station	Program
13	Program	Station	Speaker	Digital
14	Station	Program	Digital	Speaker

3. Each member needs a new letter set for each of the four trials. (No letter set should be used more than once. A total of 16 different letter sets are needed for each version.)

4. Each member needs a copy of the task instructions (four copies).

Procedure

1. Give the members the appropriate materials and ensure that the XO verifies that all four members have the same word on the appropriate matrix at the beginning of each trial.

2. Each version of the task consists of four trials, lasting 4 minutes each. The experimenter should time the trials and notify the group members when it is time to move to the next trial.

3. The experimenter should ensure that the group members use a different letter set for each trial in the task.

4. The experimenter should ensure that each member writes each word that is played on his or her individual matrices.

Social Judgment Task

Main Study Procedures

Subjects are assigned to groups and are asked to make a series of decisions that require them to make inductive inferences from a set of available information (i.e., a set of cues), each piece of which is imperfectly correlated with the criterion. For example, subjects may be evaluating the suitability of a set of job candidates or a set of graduate school applications. A test score, or grade average, is information related to probable success but imperfectly. The members of each group differ from each other in terms of how they view the specific judgments involved—the importance of various cues, how these cues should be combined, and so forth. These differences arise because the subjects have received differential training in an earlier stage of the study. The subjects are asked to make a set of judgments individually. They then work together in a group, discussing each case until they reach a joint decision. The experimenter then gives them the correct answer (in terms of some outside expert criterion) and the group moves to the next problem.

Dependent Variables of Interest

These are agreement among group members; changes in aspects of members' judgment policies (attribute weights, cue-attribute correlations, etc.); interpersonal trust: main variations include patterns of differences in judgment policies; selected versus trained policy differences; actual (ecological) pattern of relations among cues, attributes, and so forth.

Reference:

Hammond, K.R., Todd, F.J., Wilkins, M., & Mitchell, T.O. (1966). Cognitive conflict between persons: Application of the :lens model: paradigm. Journal of Experimental Social Psychology, 2, 343-360.

Task Instructions

You will be presented with 10 questions in which you will individually have to make some judgments. You will be given three facts. You will have to determine how important each fact is in developing your answers to the questions. You will have 5 minutes to consider all 10 questions, that is, 30 seconds per question. After you have individually made these judgments, your team will then be presented with five similar questions. These questions will be

discussed by your team, the facts that are presented will be rated in importance, and a final answer will be reported. You will then make private judgments about the facts and questions. The team will have 13 minutes to consider these five questions, that is, approximately 2-1/2 minutes per question. The object of this task is to get your individual and team answers as close to the correct answer as possible.

Please read the following question carefully (see Table 18). Also consider the information that is provided to help you answer the question. First consider how important each fact is in determining your answer to the question, and then determine your answer to the question. Rate the importance of each piece of information on a scale from 1 to 100, with 1 being least important and 100 being most important. Record your rating in the space provided. The importance ratings do not to need to total 100. Then determine your answer to the question and write it in the space provided. Remember you have about 30 seconds for each question.

After you have determined how important each fact is and have also determined your answer to the question, turn to the next page to learn the answer to the question. Do not turn the page until you have determined the importance values and the answer to the question.

Table 18

Question 1

Given the following information
What is the percentage of Caesarean section births in the last 7 years in hospital A?

Fact 1 Description	Value	Importance
Percentage of female obstetricians:	21.93	
Fact 2 Description:	Value	Importance
Total number of beds in hospital:	15	
Fact 3 Description:	Value	Importance
Number of births per year:	398	

Your Question Answer: _____

The correct answer to question 1 is 3.08.

Next, you will be presented with the same type of question and you will have to predict the answer based on the same type of information (see Table 19). However, the values of the facts will be different. Consider the information you have and what you have learned from the previous question. Again, determine the importance of each piece of information (rated from 1 to 100) and then determine the answer to the question. Try to get your answer as close as possible to the correct answer.

Table 19

Question 2

Given the following information What is the percentage of Caesarean section births in the last 7 years in hospital B?		
Fact 1 Description Percentage of female obstetricians:	Value 12.50	Importance
Fact 2 Description: Total number of beds in hospital:	Value 153	Importance
Fact 3 Description: .Number of births per year:	Value 476	Importance

Your Question Answer: _____

Go to the next page for the answer and the next question.

The correct answer to question 2 is 7.73.

Again, read the next question (see Table 20), consider the information you are given, and consider how your past answers have compared to the correct answers. Again, rate each fact in terms of how important you consider it. Then answer the question. You may refer to all previous questions and information when making further judgments.

Table 20

Question 3

Given the following information
What is the percentage of Caesarean section births in the last 7 years in hospital C?

Fact 1 Description	Value	Importance
Percentage of female obstetricians:	28.32	
Fact 2 Description:	Value	Importance
Total number of beds in hospital:	137	
Fact 3 Description:	Value	Importance
Number of births per year:	180	

Your Question Answer: _____

Go to the next page for the answer and the next question.

The correct answer to question 3 is 2.39.

and so forth...

This concludes the individual phase of this task. Next, you and your team will be presented with similar questions and be given the same information. You will rate the importance of that information as you did before and determine the final answers to the questions.

After your team is presented each question and the facts pertaining to the question, all of you will need to discuss what the importance ratings for each fact should be and make recommendations to the XO. After some discussion, the XO will determine the importance ratings. Then the team will discuss what the final answer should be and make their recommendations to the XO. The XO will determine the final answer.

Then privately, each of you will determine what you think the importance ratings should be and what your personal final answer should be. Do not record your private judgments until the XO has told you to do so. Do not tell the other team members what your private judgments are. Your team will have about 2-1/2 minutes to work through each question.

Table 21 shows the first question your team will be considering. Read the question, evaluate the facts, and when told to do so, make recommendations to the commanding officer.

Table 21

Question 11

Given the following information
What is the percentage of Caesarean section births in the last 7 years in hospital K?

Fact 1 Description Percentage of female obstetricians:	Value 13.56	Importance
Fact 2 Description: Total number of beds in hospital:	Value 163	Importance
Fact 3 Description: Number of births per year:	Value 922	Importance

---

Question Answer: _____

After you have recorded your responses and you have determined that all your team members have completed their private ratings, instruct them to go to the next page for the correct answer and the next question.

(next page)

The correct answer to question 11 is 10.95.

and so forth...

(Go to the next page for the correct answer when the XO tells you to do so.)

The correct answer to question 15 is _____

You have now completed the judgment task.

XO Instructions:

Before this discussion phase, all team members have been judging the same types of questions. In this discussion phase, each team member will be considering the exact same question along with the exact same facts. Instruct the team that you are open for any suggestions they may have to help you make the importance ratings. The fact importance rating method is the same as before. When you have made your decisions about the fact importance ratings, tell

the team you have made your decisions. Also tell the team what those ratings are. Then instruct the team members that you are open to suggestions about what the final question answer should be. Allow them to make suggestions. When you have made your decision, tell the other team members so. Also tell them what your final answer is.

Then, instruct the team members to decide what their own private importance ratings and answer are. These are private and are not to be communicated to you or the other team members. When you have determined that they have all made their private ratings, instruct the team to move to the next question by turning to the next page of this booklet. Remember that your team has about 2-1/2 minutes to work through each question.

Table 22 shows the first question your team will be considering. Instruct them to read the question, evaluate the facts, and offer their suggestions. When you have recorded your decisions, instruct them to make their private ratings.

Table 22

Question 11

Given the following information
What is the percentage of Caesarean section births in the last 7 years in hospital K?

Fact 1 Description	Value	Importance
Percentage of female obstetricians:	13.56	
Fact 2 Description:	Value	Importance
Total number of beds in hospital:	163	
Fact 3 Description:	Value	Importance
Number of births per year:	922	

Question Answer: _____

After you have recorded your responses and you have determined that all your team members have completed their private ratings, instruct them to go to the next page for the correct answer and the next question.

(next page)

The correct answer to question 11 is 10.95.

and so forth...

The correct answer to question 15 is _____

Tell your team members that the task is now complete.

Experimenter Instructions and Procedures

Preparing the Task Booklets

1. The 25-page booklet needs to be divided into a separate booklet for the XO and a separate booklet for the officer's team members. The XO's booklet should contain pages 1 through 11 and pages 19 through 25. The other team members should have pages 1 through 18.

2. Each time the task is administered, a different domain needs to be chosen from the domain listing (DOLI). The DOLI contains all the questions and fact descriptions associated with each domain. The domain questions and fact descriptions need to be written on pages 2 through 11, 13 through 17, and 20 through 24. The question number on the DOLI should match the question number in the booklets. In other words, all team members will be given the exact same question. The fact description numbers on the DOLI should correspond to the fact description numbers in the booklets. All team members will be given the same fact descriptions.

3. The fact values for each domain, each question, each fact, and each team member need to be transferred from the data report (DARO). The specific value on the DARO should be written in its corresponding place in the booklets. It is critical that these values be accurately transferred. These values need to be entered on pages 2 through 11, 13 through 17, and 20 through 24.

4. The values for the correct question answers also need to be transferred from the DR to their corresponding places in the task booklets. These answers should be written on pages 3 through 12, 14 through 18, and 21 through 25. It is critical that these values be transferred accurately.

Conducting the Task

1. This task has an individual and group phase. The individual phase is pages 1 through 12 for the team members, and pages 1 through 11 plus page 19 for the XO. This phase is to last 5 minutes and needs to be timed by the experimenter. The booklets have directions at the bottoms of pages 12 and 19 not to proceed further until instructed by the experimenter. The

directions to all team members tell them that they have about 30 seconds to complete each question in this phase.

2. The group phase is pages 13 through 18 for the team members and 20 through 25 for the XO. This phase is not to last more than 13 minutes and needs to be timed by the experimenter. The directions to all team members tell them that they have about 2 minutes to discuss each question in this phase.

Social Judgment Task: Criterion and Predictor Means and SDs With Weights

For each domain (1-21), the item to be predicted with its mean and standard deviation (SD) in parentheses is followed by the cues (facts) with their means and SDs in parentheses, listed in the order X1, X2, and X3. The numbers preceding the cues are arbitrary identification numbers for the SAS© (not an acronym) program that generates cue values and should be ignored. Thus, for domain 1 (the average number of visits to a museum per year for adult Americans), X1=income, X2=education, X3=age in the weighting scheme, and P1=person 1, P2=person 2, P3=person 3, and P4=person 4 referring to the four team members. Note that the weighting schemes rotate through the domains, except for domain 12 which has a unique weighting scheme.

Table 23

Criterion and Predictor Means and SDs With Weights

1	**Visits to museum (1.3, 0.2)**		**Weighting Scheme 1**			
			P1	P2	P3	P4
	1. income (22000, 2000)	X1	70	30	50	70
	3. education (12, 0.6)	X2	50	70	30	30
	2. age (32, 2)	X3	30	50	70	50
2	**Times fishing (4, 1.4)**		**Weighting Scheme 2**			
			P1	P2	P3	P4
*	5. miles to water (25, 12)	X1	30	50	50	70
	1. income (22000, 2000))	X2	70	30	70	50
	6. square miles of water (100, 40)	X3	50	70	30	30
3	**Miles on family vacation (200, 140)**		**Weighting Scheme 3**			
			P1	P2	P3	P4
	7. household income (36000, 2000)	X1	50	30	70	30
*	4. age of car (4.4, 0.3)	X2	30	50	50	70
	3. education of parents (12, 0.6)	X3	70	70	30	50

Table 23 (continued)

4	**Square feet of house (1600, 150)**		**Weighting Scheme 4**			
			P1	P2	P3	P4
	1. income (22000, 2000)	X1	70	70	30	50
	3. education (12, 0.6)	X2	30	50	70	30
	8. persons per household (2.8, 0.2)	X3	50	30	50	70
5	**Money spent on pizza (120, 15)**		**Weighting Scheme 1**			
			P1	P2	P3	P4
*	2. age (32, 2)	X1	70	30	50	70
	1. income (22000, 2000)	X2	50	70	30	30
	9. money spent on beer (60, 6)	X3	30	50	70	50
6	**Movies seen (12, 1)**		**Weighting Scheme 2**			
			P1	P2	P3	P4
	3. education (12, 0.6)	X1	30	50	50	70
	1. income (22000, 2000)	X2	70	30	70	50
	10. books bought (6, 1.5)	X3	50	70	30	30
7	**Pounds potato chips per year**		**Weighting Scheme 3**			
			P1	P2	P3	P4
*	2. age (32, 2)	X1	50	30	70	30
	11. likes football (5, 0.6)	X2	30	50	50	70
	12. cans of pop per year (60, 4)	X3	70	70	30	50
8	**Wash car (10, 0.8)**		**Weighting Scheme 4**			
			P1	P2	P3	P4
*	4. age of car (4.4, 0.3)	X1	70	70	30	50
	13. cost of car (20,000, 5000)	X2	30	50	70	30
	2. age (32, 2)	X3	50	30	50	70
9	**TV watched (18, 2)**		**Weighting Scheme 1**			
			P1	P2	P3	P4
	14. adult age (44, 2)	X1	70	30	50	70
*	15. hr reading/wk (8, 1)	X2	50	70	30	30
*	1. income (22000, 2000)	X3	30	50	70	50
10	**Money spent on clothing (1200, 150)**		**Weighting Scheme 2**			
			P1	P2	P3	P4
	2. age (32, 2)	X1	30	50	50	70
	3. education (12, 0.6)	X2	70	30	70	50
	1. income (22000, 2000)	X3	50	70	30	30

Table 23 (continued)

11	**Amount of bail (4000, 1500)**		**Weighting Scheme 3**			
			P1	P2	P3	P4
	16. prosecutor rec (7000, 1500)	X1	50	30	70	30
	17. defense (2000, 950)	X2	30	50	50	70
	18. amount taken (1200, 500)	X3	70	70	30	50
12	**Football games won (8, 3.5)**		**Weighting Scheme 5**			
			P1	P2	P3	P4
*	21. yards allowed (140, 30)	X1	50	70	30	50
	20. yards passing (175, 22.5)	X2	30	50	70	30
	19. yards rushing (315, 32.5)	X3	70	30	50	70
13	**Number of speeding tickets (2, .25)**		**Weighting Scheme 1**			
			P1	P2	P3	P4
	22. miles driven (250, 20)	X1	70	30	50	70
*	4. age of car (4.4, 0.3)	X2	50	70	30	30
*	2. age (32, 2)	X3	30	50	70	50
14	**Caesarean sections (7, 2.8)**		**Weighting Scheme 2**			
			P1	P2	P3	P4
*	25. percent female OB (20, 10)	X1	30	50	50	70
	24. beds in hospital (160, 60)	X2	70	30	70	50
	23. births (500, 200)	X3	50	70	30	30
15	**Gross domestic product growth (1.5,0.4)**		**Weighting Scheme 3**			
			P1	P2	P3	P4
	28. hourly wage (1.40, 0.4)	X1	50	30	70	30
*	27. inflation (15, 5)	X2	30	50	50	70
*	26. unemployment (8, 2)	X3	70	70	30	50
16	**Hours of public radio (4, 1.5)**		**Weighting Scheme 4**			
			P1	P2	P3	P4
	2. age (32, 2)	X1	70	70	30	50
	1. income (22000, 2000)	X2	30	50	70	30
	3. education (12, 0.6)	X2	50	30	50	70
17	**Reading achievement (8, 1)**		**Weighting Scheme 1**			
			P1	P2	P3	P4
	29. household income (36000, 6000)	X1	70	30	50	70
	15. math achievement (8, 1)	X2	50	70	30	30
	30. spending per pupil (3200, 300)	X3	30	50	70	50

Table 23 (continued)

	18 Baseball games won (81, 8)		**Weighting Scheme 2**			
			P1	P2	P3	P4
	32. hits (9, 1)	X1	30	50	50	70
*	31. earned run average (3.95, 0.2)	X2	70	30	70	50
*	33. errors (1.5, 0.2)	X3	50	70	30	30
	19 Bales of cotton (20, 4)		**Weighting Scheme 3**			
			P1	P2	P3	P4
	34. rain (18, 3)	X1	50	30	70	30
*	27. hailstorms (15, 5)	X2	30	50	50	70
	35. sunshine (10, 1)	X3	70	70	30	50
	20 Sports events attended (3, 6)		**Weighting Scheme 4**			
			P1	P2	P3	P4
*	2. age (32, 2)	X1	70	70	30	50
	1. income (22000, 2000)	X2	30	50	70	30
	36. hours watching TV (18, 2)	X3	50	30	50	70
	21 Grade point average (GPA) (2.7, 0.5)		**Weighting Scheme 1**			
			P1	P2	P3	P4
*	39. hours worked (15, 6.5)	X1	70	30	50	70
	38. Scholastic Aptitude Test (1000, 200)	X2	50	70	30	30
	37. high school GPA (3.2, 0.4)	X3	30	50	70	50

(* = negative weight)

Error Checking Rule Induction Task

Main Study Procedures

The task is a collective induction of a rule that partitions a standard deck of 52 playing cards with four suits of 13 cards into evidence that is consistent or inconsistent with the rule. The rule could be based on any combination of numerical and logical operations on suit and number. (See Table 24 for rules used during the C2V LUT.) Each individual has his own display of cards which is visible to other group members, and play begins with the viewing of one card (the same card for everyone) that is consistent with the rule. Members first propose their own hypothesis as to what the rule is. Individually, they next pick any card from several decks available to them with the instruction that they are to choose a card that they think will give them the most information. After being informed whether the chosen card fits the rule in each individual display, the group is given a limited time to discuss the problem and to propose a group hypothesis. This procedure continues for 10 trials.

Dependent Variables of Interest

These include plausibility of hypotheses based on card displays; quantity and quality of information exchange; quantity and effectiveness of error checking; social combination processes (process by which groups resolve disagreement—voting, turn taking, demonstration, generation of a new emergent group response; decision process—majority, proportionality); and group versus individual performance.

References:

Laughlin, P.R., VanderStoep, S.W., & Hollingshead, A.B. (1991). Collective versus individual induction: Recognition of truth, rejection of error, and collective information processing. Journal of Personality and Social Psychology, 61, 50-67.

McGlynn, R.P., Sutton, J.L., & Bliese, P.D. (1995, June). Information pooling in collective induction. Paper presented at the 18th Interdisciplinary Nags Head Conference on Groups, Networks, and Organizations, Highland Beach, FL.

Task Instructions

This task involves cooperative problem solving. You are not competing with each other in any way; the object is to solve a problem by cooperating with each other. First, I will explain the kind of problem you will be solving and then I will explain how you will be working on it.

The object is to figure out an arbitrary rule that divides an ordinary deck of playing cards into cards that fit and cards that do not fit the rule. Aces have the value 1, deuces 2, threes 3, up to Jacks 11, Queens 12, and Kings 13. OK? Now, the rule can be based on any characteristic of the cards. For example, the rule might be "diamonds" so that any card that is a diamond would fit the rule and all other cards would not fit the rule.

(On the master playing board, demonstrate the rule by playing 8D—the initial card—, JD, JC, 5H, 4D from the pre-arranged deck while asking the participants "does this fit the rule or not?" for each card after the initial card.) While playing the cards, say

"Notice how I place the cards in a display with cards that fit the rule across the top row to the right of the last card played and cards that do not fit the rule down the columns under the last card played. One more thing: rules are based on the face side of the cards ONLY and NOT on the back side of the cards (indicate back of cards)."

Table 24

Rules and Starting Cards

Version	Error checking (EC) rule induction task Rule	Starting card
1	CHDS	7C
2	RRBB	8H
3	HHCCC	8H
4	BRBB	8S
5	OEOO	7C
6	card >= 4	8H
7	BRR where red cards must be a pair	7S
8	Cards decrease by 4 then increase by 2 (ex.876567654345)	8D
9	RBRBB	8D
10	4 < card <J	7S
11	card > 7	8C
12	EOOO	8D
13	HDSC	7H
14	A <card <8	7C
15	RRBB	7D
16	BRBRR	8S
17	Even black	8S
18	card <+ 7	7H
19	OOEE	7C
20	DSDD	8D
21	BBRR	8C

C=club D=diamond H=heart S=spade B=black cards R=red cards O=odd cards E=even cards A=ace K=king Q=queen J=jack 1-10 = cards 1-10 (<)= less than (<=) =less than or equal to (>) = greater than (>=) = greater than or equal to

(Ensure that everyone understands the rule and how the cards are played.)

"Or the rule might be 'even diamonds'."

(Demonstrate the rule as above by playing 6D, 6C, QD, 2S).

"Or the rule might be 'even diamonds or clubs above the six'."

(Demonstrate the rule as above by playing QC, 9S, 8H, 10D, AC).

"Or the rule might be something like 'odd spades alternate with even clubs'."

(Demonstrate the rule as above by playing 3S, 4H, 4C, QH, JS).

"So, all those are just examples of what the rule might be. The rule can be anything. It might be based on number, suit, color, a pattern like alternation, or any combination of any characteristics. So you see the rule might be pretty simple or it might be pretty complex. Are there any questions about what I mean by a rule?"

(Answer any questions as much as possible by repeating relevant parts of the instructions).

"In the problem you will be solving, I will start you with one card that does fit the rule, then you try to decide what the rule is by picking any card you want from the decks in front of you, and I will tell you whether they follow the rule. If a card you pick fits the rule, I will place it across the top row; otherwise, I will place it below the last card played just like we did before. Any questions so far?"

(Ensure that everyone understands).

Have all participants PRINT their names on the "Individual Hypothesis" sheet.

Give the XO the "Hypothesis After Discussion" sheet.

Deliver instructions exactly as quoted:

"For this task, we are going to have all four of you cooperate in solving one of these problems. The XO will make all final decisions and keep track of the answers on the sheet labeled 'Hypothesis After Discussion'."

"I will start all of you with the same first card that fits the rule. Write that card on your Individual Hypothesis sheet (indicate where). Of course, the first card will fit a lot of rules. The first step is to write an hypothesis or guess about what the rule might be. That is, form your own hypothesis before any discussion and write it on your individual sheet where it says 'Hypothesis'."

"When you write your hypothesis, use the abbreviations D for diamonds, C for clubs, H for hearts, S for spades, A for ace, J for jack, Q for queen, K for king, and ensure that it is written so we can understand exactly what you meant."

"After you write your hypothesis, I will signal you to begin discussing the problem to select a single hypothesis. The single hypothesis is the one the XO chooses after group discussion. The XO should write the hypothesis on the 'Hypothesis After Discussion' sheet (indicate where)."

"After that, you each will choose any one of the 52 cards from the decks in front of you to test your hypothesis. You can pick any one of the cards from the decks in front of you. Place the card selected in the lower left corner of the playing board. I will let you know if it fits the rule by putting it in the display just like we did before. Then you write what card you played on your individual sheet (indicate where). Choose the card that you think will give you the most information. There are several decks, so you can play the same card more than once."

"Then the process starts all over again with each of you: writing an individual hypothesis, discussing the problem, choosing a single hypothesis, and playing a card, and so forth until 12 cards have been played. Then you will make your final hypotheses. The final single hypothesis will be your final answer to the problem. Any questions?"

(For each trial, ensure that card choices, individual hypotheses, and group hypotheses are written and legible.)

From the Confidential rule sheet, determine what the rule is for the version being played. Find the designated starting card for each participant (from one of each player's decks), and place that card in the upper left corner of the playing board. Participants will begin play by writing their individual hypotheses.

Supervise the procedure by letting participants know when they may begin discussion of each trial.

Experimenter Instructions and Procedures

Step 1. Place the fact sheets for the version you are administering in individual 8.5- by 11-inch envelopes and label those envelopes "Team Member No. 1," "Team Member No. 2," "Team Member No. 3," and "Team Member No. 4."

Step 2. Enter the appropriate information on participants' Part I and Part II instruction-response sheets. This includes the test day (options are 1-10), cell (options are 1-4), version (options are 1-14), team member number (options are 1-4 with 1 being the XO), and team number (options are 1-8).

Step 3. Give each team member a copy of the participant instructions and answer procedural questions after the instructions have been read by all participants.

Step 4. Give each team member the appropriate Part I pre-discussion instruction-response sheet and tell him or her to begin Part I. Instruct the team members that they have 7

minutes to privately review their individual facts sheets and make their pre-discussion alternative selection.

Step 5. After the 7 minutes have expired and all participants have written their alternative preference in the designated space, pick up the Part I instruction-response sheets, the individual fact sheets, and the envelopes. Distribute the Part II instruction-response sheets. Ensure that Team Member No. 1 receives the instructions labeled "XO Instructions."

Step 6. Instruct the participants that they have 23 minutes to discuss the problem, after which the XO is to indicate his selection of best solution in the designated space. Remind the participants that during the first part of the discussion, they should avoid stating a preference or indicating which alternative they personally think is best. Rather, they should try to recall and review all the relevant and important information. Only when they all feel that they have discussed all the important information about each alternative should they proceed to the second part of the discussion. During the second part of the discussion, they should try to reach a decision about which alternative is the best solution to the stated problem. During this decision-making phase, they are free to express their preferences at any time.

Step 7. When the 23 minutes have expired, stop the experiment and ensure that the XO has indicated his post-discussion alternative preference in the designated space. Note. The discussion can end earlier if the XO has made a decision and written that decision in the space provided.

SUMMARY

Application to the C2V Limited User Test

The U.S. Army is developing a tracked C2V to increase battle staff mobility. The battle staff is required to operate while moving over rough terrain and to be able to communicate with team members inside the vehicle and between vehicles. A LUT was conducted to discover if movement impaired the ability of crews to work effectively as a team, determine if performance deteriorated when soldiers in adjacent C2Vs were required to integrate their activities, and ascertain the impact of terrain on group performance (Beck & Pierce, 1998). The test used two C2V prototypes, staffed with a four-person team. Each team member operated a workstation in the vehicle's mission module. The evaluation design was similar to 2 (Movement: Stationary, Moving) x 2 (Terrain: Paved, Course A) x 2 (Communication: Intravehicle, Intervehicle) with the baseline occupying the position of the nonfitting control arrangement. Four group performance tasks from the final task list were selected for implementation.

Tasks for the test were evaluated according to their feasibility for administration in the C2V and the likelihood that they tapped a group function of interest. The tasks selected for use during the C2V LUT were the nonsummation (renamed sentence construction), Scrabble 2, Social Judgment, and Quiz Tasks. It was concluded that the C2V environment impaired performance of all group performance tasks, especially those that required a great degree of coordination and integration.

Future Research and Team Performance Task Battery Development

The main shortcoming of the team performance task battery was that the tasks were logically rather than empirically related to the group functions (Beck & Pierce, 1998). Given that the association of performance tests to group functions is probably highly complex, any logically derived set of tasks must be validated. Also, tasks will probably be sensitive to multiple functions, and this interactivity will need to be considered in any application of the task battery. Finally, the proposed functions inferred from the literature should be evaluated in the context of battle command. A series of empirical investigations may reveal different factors than originally proposed.

The need for a team performance task battery to support testing of military systems is directly linked to the rising complexity of the modern battlefield because of the development of information age technology. The use of more and better knowledge of the battlefield requires that battlefield information be acquired, processed, and disseminated in an accurate and timely manner. Certainly military systems will have to be effective, and military personnel will have to be competent, but beyond that, successful battle performance will be based on the interaction between and among teams. Empirical development of a reliable, valid team performance task battery will support the acquisition of military systems by providing a way to evaluate the impact of system implementation on team performance.

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13. ABSTRACT *(Maximum 200 words)*

Requirements for mobility and speed in battle command led to the development of a mobile, digitized command and control vehicle (C2V). Conducting battle command in a C2V impacts how the individual and team will acquire, process, and disseminate information. To test the effect that the C2V will have on battle command performance requires an evaluation of both individual and team performance. Cognitive test batteries exist to assess individual performance. The current effort was to develop a task battery for use in evaluating team performance. Four team performance functions (information exchange, resource matching, coordination, and error checking) were proposed and used to guide the selection of tasks to form a team performance task battery. Tasks were selected from a large sample of group tasks identified and assessed for applicability to the team performance functions. Tasks that most exemplified each of the four functions and that could be used to support the C2V test were compiled into a task list and developed for implementation. Task development included creating, gathering, or assembling stimulus materials, instructions, and test protocols. Manual versions of all the selected tasks and digital versions of some tasks were developed. A sufficient number of replications of each task were developed to support the C2V test design. Four of the tasks developed were used during the C2V test. It was concluded that the C2V environment impaired performance of all group performance tasks, especially those that required a great degree of coordination and integration. Future research must expand this initial effort to empirically define and validate team functions and related tasks.

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